BS EN 60068-2-39:2016

BSI Standards Publication

Environmental testing

Part 2-39: Tests — Tests and guidance: Combined temperature or temperature and humidity with low air pressure tests

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National foreword

This British Standard is the UK implementation of EN 60068-2-39:2016. It is identical to IEC 60068-2-39:2015. It supersedes BS EN 60068-2-39:1999 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/104, Environmental conditions, classification and testing.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Date	Text affected

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English Version

Environmental testing - Part 2-39: Tests - Tests and guidance: Combined temperature or temperature and humidity with low air pressure tests (IEC 60068-2-39:2015)

Essais d'environnement - Partie 2-39: Essais - Essais et lignes directrices: Essais combinés de température ou de température et d'humidité à basse pression atmosphérique (IEC 60068-2-39:2015)

Umgebungseinflüsse - Teil 2-39: Prüfverfahren - Prüfungen und Leitfaden: Kombinierte Prüfung der Temperatur oder Temperatur und Feuchte mit niedrigem Luftdruck (IEC 60068-2-39:2015)

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The text of document 104/657/FDIS, future edition 2 of IEC 60068-2-39, prepared by IEC/TC 104 "Environmental conditions, classification and methods of test" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60068-2-39:2016.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2016-07-22
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2019-01-22

This document supersedes EN 60068-2-39:1999.

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In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60068-2 (series)	NOTE	Harmonized as EN 60068-2 (series).
IEC 60068-2-1	NOTE	Harmonized as EN 60068-2-1.
IEC 60068-2-2	NOTE	Harmonized as EN 60068-2-2.
IEC 60068-2-13	NOTE	Harmonized as EN 60068-2-13.
IEC 60068-3-1	NOTE	Harmonized as EN 60068-3-1.

Annex ZA
(normative)
Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60068-1	-	Environmental testing -- Part 1: General and guidance	EN 60068-1	-
IEC 60068-2-78	-	Environmental testing -- Part 2-78: Tests - Test Cab: Damp heat, steady state	EN 60068-2-78	-

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ENVIRONMENTAL TESTING –

Part 2-39: Tests – Tests and guidance: Combined temperature or temperature and humidity with low air pressure tests

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 60068-2-39 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 1976 and constitutes a technical revision.

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

a) preferred severities of the IEC 60068 series;
b) combined temperature, humidity and low air pressure

The text of this standard is based on the following documents:

FDIS	Report on voting
104/657/FDIS	104/661/RVD

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

This publication 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

INTRODUCTION

Equipment and components are required to function without significant reduction in performance when subjected to different environmental parameters. The combination of temperature, humidity and low air pressure may have certain effects on components and gaskets, for example.

The type and severity of the environmental parameters depend on the operational, transport and storage environments to which the equipment and components are subjected. The environmental effects on the performance of equipment in the tropics and subtropics are totally different from those in arctic regions. Individual environmental parameters cause a variety of different and overlapping effects on the equipment and components.

The manufacturer attempts to ensure, and the user expects, that equipment and components will survive the environments to which they will be subjected throughout their useful life. This expectation can be assessed by exposure of the specimen to a range of simulated environmental parameters controlled in the laboratory. The severity of the environmental parameters is often increased to obtain meaningful results in a relatively short period of time. This allows assessment of the likely effects of applied environmental conditions.

ENVIRONMENTAL TESTING –

Part 2-39: Tests – Tests and guidance: Combined temperature or temperature and humidity with low air pressure tests

1 Scope and object

This part of IEC 60068 provides a description of test methods and guidance for testing of equipment or components under combined temperature or temperature and humidity with low air pressure tests.

The object of combined testing is to investigate to what extent the equipment or components are affected by combined temperature or temperature and humidity with low air pressure tests.

The method of combined tests detects electrical, mechanical or other physical variations.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

3 Terms and definitions

None.

4 Testing

4.1 General

All values of test parameters such as cold, dry heat, low air pressure, humidity, exposure time and conditions such as state of operation and so on, should be selected from the IEC 60068-2 series or the relevant specification.

The duration of exposure shall be measured from the time when temperature stability of the specimen has been reached under conditions of low air pressure. Temperature stability shall be according to IEC 60068-1.

It should preferably be tested with low air velocity.

4.2 Preferred combinations

Preferred combinations of temperature, low air pressure and duration shall be selected from Table 1.

Table 1 – Test severities

Temperature °C	Low air pressure kPa	Duration h
–55	5	2
–55	15	2
–55	25	2
–55	40	2
–40	55	2 or 16
–40	70	2 or 16
–25	55	2 or 16
40	55	2
55	15	2
55	25	2
55	40	2
55	55	2 or 16
55	70	2 or 16
85	5	2
85	15	2
155	5	2
155	15	2

4.3 Initial measurement and functional performance test

The specimen shall be submitted to the visual, dimensional and functional checks specified by the relevant specification.

4.4 Test procedure

4.4.1 Preconditioning

The relevant specification may require preconditioning of specimen.

4.4.2 Test with temperature and low air pressure

Figure 1 and Figure 2 show examples of test sequence with temperature and low air pressure.

The specimen shall be introduced in the chamber as required (unpacked, switched on or off, etc.).

The temperature within the chamber shall be adjusted to the required temperature as determined in 4.1. The rate of temperature change should not exceed 1 K/min. The specimen shall be allowed to reach temperature stability.

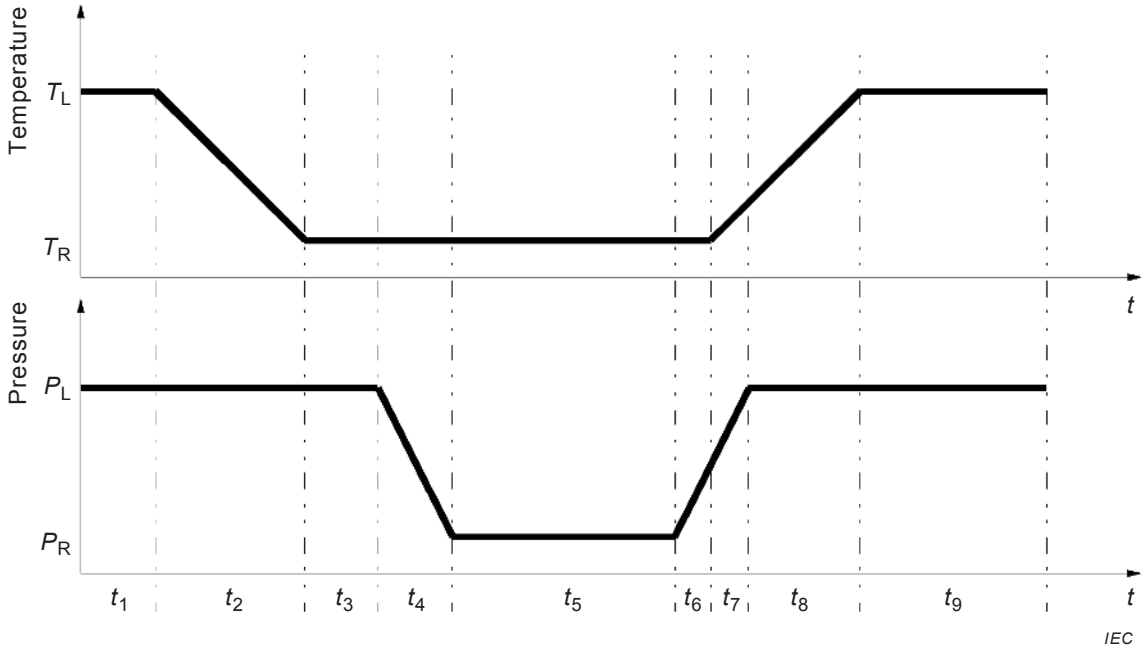
In the case of electrically-operated specimens, a function check shall be made in accordance with the relevant specification. Intermediate measurements shall be performed as required or specified in the relevant specification.

The pressure in the chamber shall then be reduced to the required value as determined in 4.1. The rate of change of pressure should not exceed 15 kPa/min.

The conditions of temperature and low air pressure shall be maintained for the required duration as determined in 4.1.

The low air pressure shall then be restored to normal pressure, at a rate not exceeding 15 kPa/min. During the increase of pressure, the temperature does not need to be controlled. The specimen remains within the chamber until the temperature reaches standard atmospheric conditions. The rate of temperature change should not exceed 1 K/min.

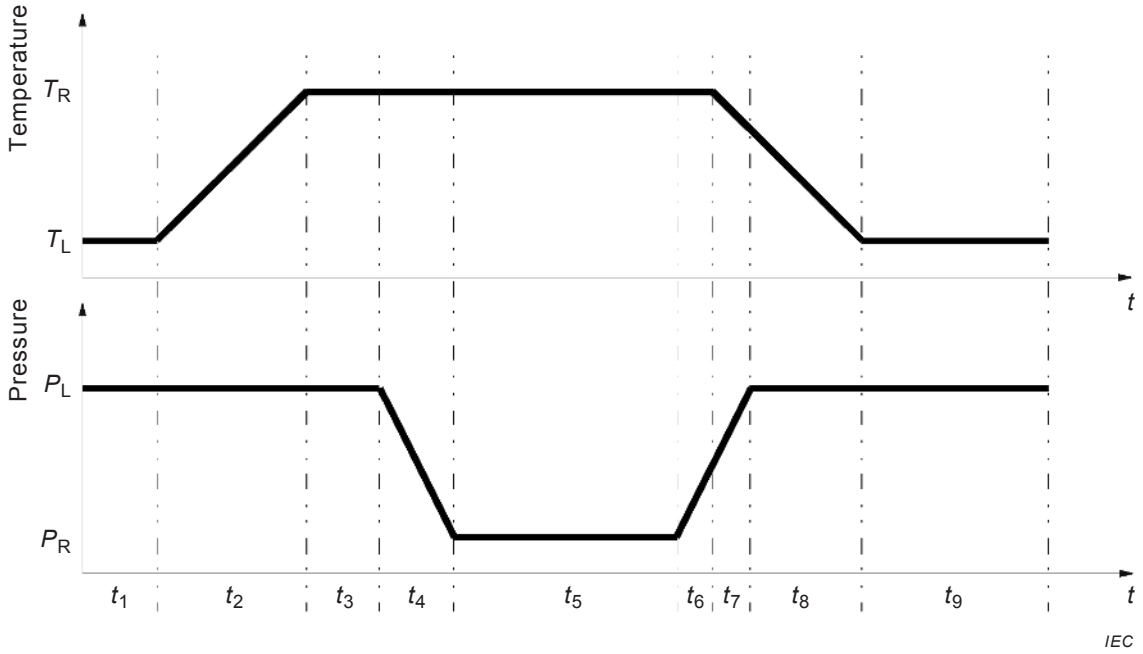
The specimen shall then be subjected to the recovery procedure as required.



Key

P_L	pressure at laboratory
P_R	pressure required
T_L	temperature at laboratory
T_R	temperature required
t_1	duration of preconditioning at P_L and T_L
t_2	duration of temperature change from T_L to T_R
t_3	duration to reach required temperature stability T_R
t_4	duration of pressure change from P_L to P_R
t_5	test duration as defined in Table 1
t_6 plus t_7	duration of pressure change from P_R to P_L
t_7 plus t_8	duration of temperature change from T_R to T_L
t_9	duration of recovery at P_L and T_L

Figure 1 – Example of test sequence with cold temperature and low air pressure



Key

P_L	pressure at laboratory
P_R	pressure required
T_L	temperature at laboratory
T_R	temperature required
t_1	duration of preconditioning at P_L and T_L
t_2	duration of temperature change from T_L to T_R
t_3	duration to reach required temperature stability T_R
t_4	duration of pressure change from P_L to P_R
t_5	test duration as defined in Table 1
t_6 plus t_7	duration of pressure change from P_R to P_L
t_7 plus t_8	duration of temperature change from T_R to T_L
t_9	duration of recovery at P_L and T_L

Figure 2 – Example of test sequence with dry heat and low air pressure

4.4.3 Test with temperature, humidity and low air pressure

Figure 3 shows an example of test sequence of temperature and humidity with low air pressure.

The specimen shall be introduced in the chamber as required (unpacked, switched on or off, etc.)

The temperature within the chamber shall be adjusted to the required temperature as determined in 4.1. The rate of temperature change should not exceed 1 K/min. The specimen shall be allowed to reach temperature stability.

A functional test shall be carried out in accordance with the relevant specification. Intermediate measurements shall be performed as required or specified in the relevant specification.

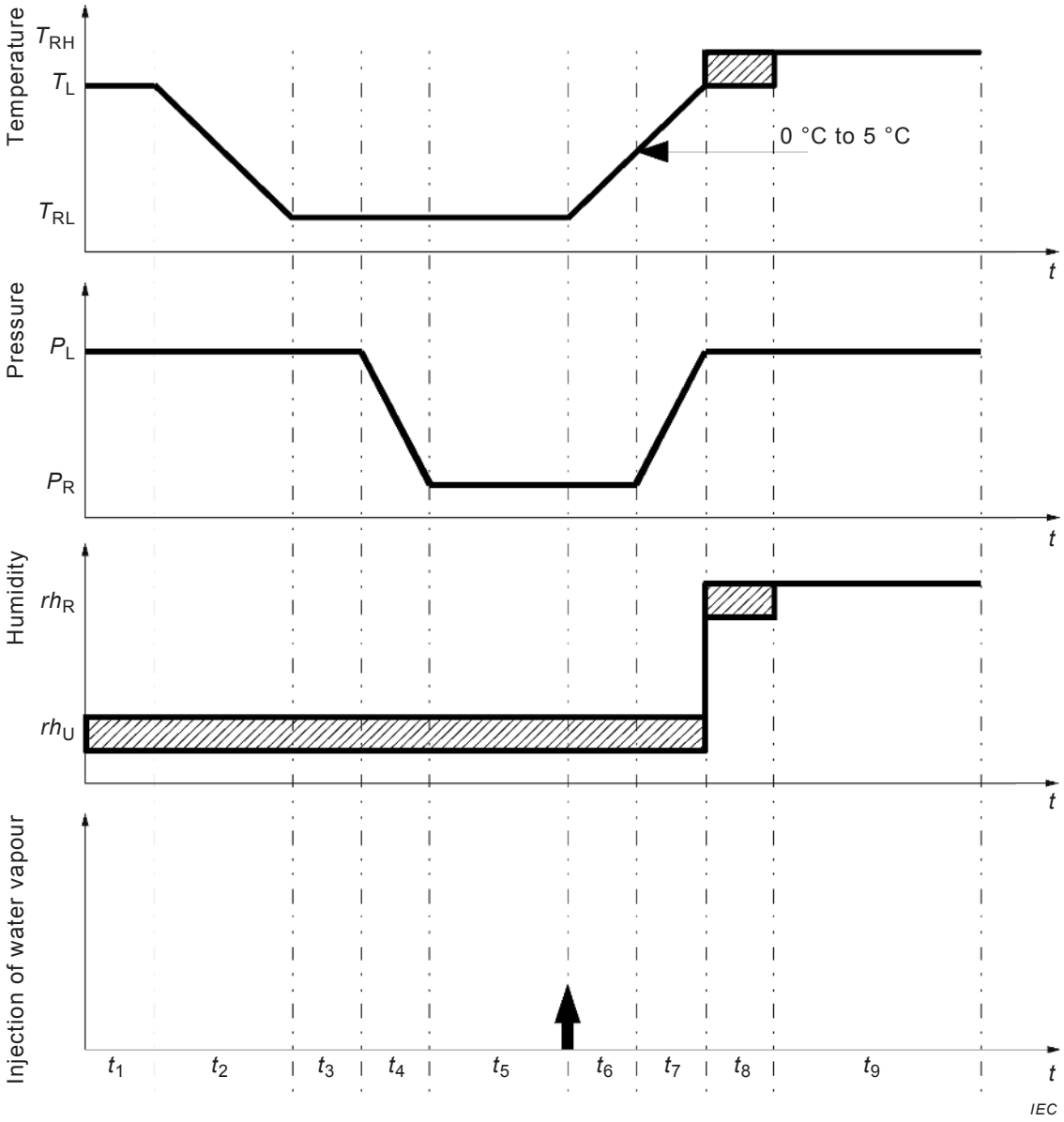
With the temperature still maintained at the required value as determined in 4.1, the air pressure in the chamber shall then be reduced to the required value as determined in 4.1. The rate of change of pressure should not exceed 15 kPa/min.

The conditions of temperature and low air pressure shall be maintained for the required duration as determined in 4.1.

Water vapour shall then be injected at a rate sufficient to cause frost to form on the specimen. After that, the temperature shall be raised to laboratory temperature, while the low air pressure is constant.

When the rising temperature has reached a value between 0 °C and 5 °C, the low air pressure shall be restored to normal pressure with a rate not exceeding 15 kPa/min. During the increase of pressure, the temperature does not need to be controlled. The temperature and humidity shall be stabilized at the required values; refer to the relevant specification or IEC 60068-2-78. The conditions of temperature and humidity shall be maintained for the required duration as determined in 4.1.

The specimen shall then be subjected to the recovery procedure as required.



Key

P_L	pressure at laboratory
P_R	pressure required
rh_R	relative humidity required
rh_U	relative humidity uncontrolled
T_L	temperature at laboratory
T_{RH}	temperature required according to IEC 60068-2-78 or relevant specification
T_{RL}	temperature required causing frost on the specimen
t_1	duration of preconditioning at P_L, T_L and rh_U
t_2	duration of temperature change from T_L to T_{RL}
t_3	duration to reach required temperature stability at T_{RL}
t_4	duration of pressure change from P_L to P_R
t_5	test duration as defined in Table 1
t_6 plus t_7	duration of temperature change from T_{RL} to T_L
t_7	duration of pressure change from P_R to P_L
t_8	duration to reach required T_{rh} and rh_R
t_9	duration at T_{rh}, P_L and rh_R

NOTE Humidity will not stay constant while temperature is changing.

Figure 3 – Example of test sequence of temperature and humidity with low air pressure

5 Final measurements

The specimen shall be submitted to the visual, dimensional and functional checks prescribed by the relevant specification.

The relevant specification shall provide the criteria upon which the acceptance or rejection of the specimen is to be based.

6 Information to be given in the relevant specification

The relevant specification shall contain the following details as far as they are applicable:

a) duration of exposure;
b) temperature for low air pressure;
c) value of low air pressure;
d) value of temperature for humidity;
e) value of humidity;
f) type of test procedure;
g) preconditioning;
h) type and scope of initial measurement;
i) type and scope of intermediate measurement;
j) recovery;
k) type and scope of final measurement;
l) criteria for evaluation;
m) type and scope of test report.

7 Information to be given in the test report

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

a)	Customer	(name and address)
b)	Test laboratory	(name and address and details of accreditation – if any)
c)	Test dates	(dates when test was run)
d)	Type of test procedure	(e.g. temperature, humidity and low air pressure)
e)	Required values	(temperature, low air pressure etc.)
f)	Purpose of test	(development, qualification, etc.)
g)	Test standard, edition	(IEC 60068-2-39, edition used)
h)	Relevant laboratory test procedure	(code and issue)
i)	Test specimen description	(drawing, photo, quantity, build status, etc.)
j)	Test chamber	(manufacturer, model number, unique id, etc.)
k)	Performance of test apparatus	(set point temperature control, air flow etc.)
l)	Air velocity and direction	(air velocity and direction of incident air to the specimen)
m)	Uncertainties of measurement system	(uncertainties data, including temperature stability of transducer sensitivities)

n)	Calibration data	(last and next due date)
o)	Initial, intermediate and final measurements	(initial, intermediate and final measurements)
p)	Required severities	(from relevant specification)
q)	Test severities	(measuring points, data, etc.)
r)	Performance of test specimens	(results of functional tests etc.)
s)	Observations during testing and actions taken	(any pertinent observations)
t)	Summary of test	(test summary)
u)	Distribution	(distribution list)

NOTE Text in brackets serves as explanations.

Annex A
(informative)

Guidance on combined temperature or temperature and humidity with low air pressure testing

A.1 General

Annex A furnishes fundamental comments for applying combined tests of temperature or temperature and humidity and low air pressure based on different parts within the IEC 60068-2 series.

For the purposes of combined testing, IEC 60068-1 shall be used together with the relevant preferred values described in the IEC 60068-2 series.

A.2 Environmental effects

A.2.1 The following effects on the specimen are considered to be due to the combination of temperature and low air pressure:

a) Increase of surface temperature and changes of temperature gradients of heat dissipating specimens in comparison with the specified values are due to the decrease of the convection coefficient, at low air pressure. Although the increase of surface temperatures can be achieved by using a higher test temperature at normal air pressure, this test temperature value cannot be properly established and the correct temperature gradients cannot be achieved without combining with low air pressure.

b) Changes in functional or safety characteristics of specimen due to changes with low air pressure and temperature of dielectric properties of air. At low air pressure, particularly when combined with high temperature, there is a marked reduction of air dielectric strength with the consequent increased risk of arc, surface or corona discharges.

c) Changes in material characteristics due to cold or heat increase the risk that sealed equipment or component will be deformed or cracked at low air pressure.

A.2.2 Other effects due essentially to temperature but remarkably accelerated by low air pressure are:

a) volatilization of plasticizers and of degradation products from plastics, with changes in the mechanical and electrical characteristics of individual parts of the specimen. These evaporated products can condense on nearby surfaces and/or produce changes of characteristics, corrosion and/or degradation,

b) evaporation of lubricants with possible blocking of moving parts, and

c) dissolved gas evolution from liquids; the reduced low air pressure can result in transitory boiling, with a possible leakage of liquid.

A.3 Measurement of temperature

The efficiency of thermal exchange between test atmosphere and sensing elements of the thermometer used for air temperature monitoring is reduced by the convection coefficient decrease associated with low air pressure.

As a consequence:

– the response time of the thermometers to temperature changes is greater than at normal pressure.

– the thermometer can be more sensitive to heat radiation from the specimen.

To address these consequences, a shield may be placed between the thermometer and the specimen to reduce the effect of the heat radiation. To compensate for the response time of thermometer a longer measurement time may be required.

Bibliography

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

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

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

IEC 60068-2-13, *Basic environmental testing procedures – Part 2-13: Tests – Test M: Low air pressure*

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

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