IEC 60068-2-38

Edition 3.0 2021-03
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Environmental testing –
Part 2-38: Tests – Test Z/AD: Composite temperature/humidity cyclic test

IEC 60068-2-38:2021-03 RLV(en)

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2021 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC online collection - oc.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

IEC 60068-2-38

Edition 3.0 2021-03
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Environmental testing –
Part 2-38: Tests – Test Z/AD: Composite temperature/humidity cyclic test

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 19.040

ISBN 978-2-8322-9633-2

Warning! Make sure that you obtained this publication from an authorized distributor.

® Registered trademark of the International Electrotechnical Commission

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

CONTENTS

FOREWORD 4
1 Scope 6
2 Normative references 6
3 Terms and definitions 6
4 General 7
4.1 Description of the test 7
4.2 Application of the test 7
5 Description of test chamber 8
5.1 General 8
5.2 Chamber for exposure to moisture 8
5.3 Chamber for exposure to cold 9
6 Severities 9
7 Testing procedure 9
7.1 Preconditioning 9
7.2 Initial measurements 10
7.3 Conditioning 10
7.4 Test cycle 13
7.4.1 Description of temperature/humidity subcycle 13
7.4.2 Description of cold subcycle 14
7.4.3 Description of 24 h cycles with no exposure to cold 15
7.4.4 Description of final cycle 15
7.4.5 Intermediate measurements 15
7.5 Final measurements 17
7.5.1 Introductory remarks 17
7.5.2 At high humidity 18
7.5.3 Immediately upon removal from the chamber 18
7.5.4 After final drying 18
8 Information to be given in the relevant specification 18
9 Information to be given in the test report 19
Annex A (informative) Supporting documentation for test sequence 21
A.1 General 21
A.2 Preconditioning 21
A.3 Exposure to humidity followed by exposure to cold 22
A.4 Exposure to humidity not followed by exposure to cold 23
Bibliography 24

Figure 1 – Preconditioning 10
Figure 2 – Exposure to humidity followed by exposure to cold 12
Figure 3 – Exposure to humidity not followed by exposure to cold 13
Figure 4 – Test times for intermediate operation of specimen – Exposure to humidity followed by exposure to cold 16
Figure 5 – Test times for intermediate operation of specimen – Exposure to humidity not followed by exposure to cold 17

Documents
Document Sharing Hub
Full document details: IEC 60068-2-38 2021 RLV

Table A.1 – Relative humidity tolerances 21
Table A.2 – Temperature tolerances 21
Table A.3 – Tolerances of relative humidity and temperature during exposure to humidity followed by exposure to cold 22
Table A.4 – Tolerances of relative humidity and temperature during exposure to humidity not followed by exposure to cold 23

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENVIRONMENTAL TESTING –

Part 2-38: Tests –
Test Z/AD: Composite temperature/humidity cyclic test

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
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 IEC 60068-2-38:2009. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

IEC 60068-2-38 has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test. It is an International Standard.

This third edition cancels and replaces the second edition, published in 2009. This edition constitutes a technical revision.

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

a) the figures have been updated;

b) changes to the wording has been made for clarification purposes.

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

Draft	Report on voting
104/891/FDIS	104/896/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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.

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

ENVIRONMENTAL TESTING –

Part 2-38: Tests –
Test Z/AD: Composite temperature/humidity cyclic test

1 Scope

This part of IEC 60068 ~~provides~~ specifies a composite test procedure, primarily intended for component type specimens, to determine, in an accelerated manner, the resistance of specimens to the deteriorative effects of high temperature/humidity and cold conditions.

This test standard does not apply to specimens that are energized during the complete test. Specimens can be energized during the constant phases of the tests. Measurements on energized specimens are typically carried out during constant phases of the test unless specified otherwise.

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 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*~~

~~IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*~~

~~IEC Guide 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*~~

IEC 60068-2-67, *Environmental testing – Part 2-67: Tests – Test Cy: Damp heat, steady state, accelerated test primarily intended for components*

3 Terms and definitions

No terms and definitions are listed in this document.

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

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

4 General

4.1 Description of the test

Test Z/AD is a cyclic temperature/humidity test which is designed to reveal defects in test specimens caused by "breathing" as distinct from the absorption of moisture.

This process can be initiated by the forming of condensation on the specimen's surface. As the temperature on parts or the whole of the specimen's surface might be lower than the corresponding dew point at the humidity value, water can accumulate in small cracks or gaps on the specimen's surface.

Once the air temperature is reduced, the air in internal voids of specimen is contracted which results in a drop of pressure and drawing-in either wet air or condensed water through cracks or other leaks inside the specimen. The wet air will condense on inner walls of a void and may gradually fill it. During the temperature rising phase, the air in the void is expanded, this time with a lower dew point than during drawing-in, and partially escape out. This cycle is repeated, and water can be accumulated inside the specimen and may gradually fill its voids.

This so-called "breathing" effect is caused by changing the temperature inside the specimen in an atmosphere with high humidity. During the excursion to sub-zero temperature phase of the test, the water trapped in cracks and other voids freezes and due to the expansion of ice volume the cracks extend, and new cracks can form.

This test differs from other cyclic damp heat tests in that it derives its increased severity from:

a) a greater number of temperature variations or "~~pumping~~ breathing" actions in a given time;

b) a greater cyclic temperature range;

c) a higher cyclic rate of change of temperature;

d) the inclusion of a number of excursions to sub-zero temperatures.

The accelerated breathing and the effect of the freezing of trapped water in cracks and fissures are the essential features of this composite test.

It is emphasized, however, that the freezing effect will occur only if the fissure dimensions are large enough to allow the penetration of a coherent mass of water as is normally the case in fissures between seals and metal assemblies, or between seals and wire terminations.

The degree of condensation will depend mainly upon the thermal time constant of the surface of the test specimens and may be negligible for very small specimens but copious for large specimens.

Similarly, the breathing effect will be more apparent on specimens which contain relatively large air-filled or gas-filled voids, but again, the severity of the test will depend to some extent on the thermal characteristics of the specimens.

The condensation effect and the temperature distribution could be disturbed by functional checks, therefore the checks should be carried out during the constant phases of the temperature profiles (Figure 2 and Figure 3, areas B and F).

To simply the programming of the test sequences, the set points are given in Annex A.

4.2 Application of the test

For the reasons given above, it is recommended that this test procedure be limited to component type specimens when the construction of the specimens suggests a "breathing" type of damp

AVA Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

heat test combined with icing and where the thermal characteristics are compatible with the rates of change of temperature, etc., of test Z/AD.

For solid type specimens, for example plastic encapsulated, where there may be small hairline cracks or porous material, the absorption or diffusion mechanisms will predominate and a steady damp heat such as test C of IEC 60068-2-78 is preferred for investigating these effects.

For larger specimens such as equipment or when it is essential for components to ensure thermal stability during the various phases of the cycle, test Db of IEC 60068-2-30 should be employed, although due to the reduced number of cycles in a given period, the degree of acceleration may not be as fast. In this case, test Db should normally form part of a sequence such as that defined in IEC 60068-1.

As in other damp heat tests, a polarizing voltage or electrical loading may be applied to the specimens. In the case of electrical loading, the loading should be such that the temperature rise of the specimens does not unduly affect the chamber conditions.

From the above, test Z/AD should not be considered to be interchangeable with, or an alternative to, either steady-state or other cyclic damp heat tests, but the choice of test procedure should be made with due regard for the physical and thermal characteristics of the test specimens and the types of failure mechanisms which are significant for each particular case.

5 Description of test chamber

5.1 General

The exposure to moisture, followed by cold, can either be performed in one chamber or in two separate chambers.

NOTE All temperatures and humidity values measured refer to a supply air measurement of the test chamber.

5.2 Chamber for exposure to moisture

The chamber for the exposure to moisture shall be so constructed that:

a) the temperature can be varied between 25 °C ± 2 K and 65 °C ± 2 K in a period of between 1,5 h and 2,5 h for both rising and falling temperatures;

b) the relative humidity can be maintained at $\left(93^{+3}_{-3}\right)$ % during the periods of constant or rising temperature and between 80 % ~~RH~~ and 96 % ~~RH~~ during the falling temperature periods;

c) the conditions prevailing at any point in the working space are uniform and are as similar as possible to those prevailing in the immediate vicinity of suitably located temperature- and humidity-sensing devices;

   The air in the chamber shall therefore be continuously stirred at a rate necessary to maintain the specified conditions of temperature and humidity.

d) the specimens under test shall not be subjected to radiant heat from the chamber conditioning processes;

e) ~~water used for the maintenance of chamber humidity shall have a resistivity of not less than 500 Ωm~~ the water used for the chamber humidity system shall comply with the limits given in IEC 60068-2-67;

f) condensed water shall be continuously drained from the chamber and not used again unless it has been re-purified.

Precautions shall be taken to ensure that no condensed water from the walls and roof of the test chamber can fall on the specimens.

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

5.3 Chamber for exposure to cold

The chamber for exposure to cold shall be so constructed that

a) the temperature can be maintained at –10 °C ± 2 K,

b) the conditions prevailing at any point in the working space are uniform and are as similar as possible to those prevailing in the immediate vicinity of suitably located temperature-sensing devices.

The air in the chamber shall therefore be continuously moving.

Care ~~shall~~ should be taken that the thermal capacity of the specimen under test does not appreciably influence conditions within the chamber.

The humidity chamber may be used for exposure to cold, in which case it shall meet the requirements of 4.1 and, in addition, shall be so constructed that

1) the temperature can be lowered from 25 °C ± 2 K to −10 °C ± 2 K in a period of not more than 30 min,

2) the specimen can be held at a temperature of −10 °C ± 2 K for a period of 3 h,

3) the temperature can be raised from −10 °C ± 2 K to 25 °C ± 2 K in a period of not more than 90 min.

6 Severities

The number of 24 h cycles shall be 10, unless otherwise specified. If other than 10, the relevant specification shall define the number.

7 Testing procedure

7.1 Preconditioning ~~(see Figure 1)~~

Unless otherwise specified, the specimens in the unpacked, switched-off, ready-for-use state shall be subjected to the conditions for "assisted drying" specified in IEC 60068-1 (55 °C ± 2 K with a relative humidity not exceeding 20 %) for a period of 24 h prior to the first cycle of the damp heat test.

The specimens shall then be allowed to attain thermal stability at standard atmospheric conditions for testing or, as otherwise specified, before the initial measurements are made.

Figure 1 gives an overview about the preconditioning phase. During the stabilizing period no specific rate of cooling is specified, however it shall not exceed 1 K/min.

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

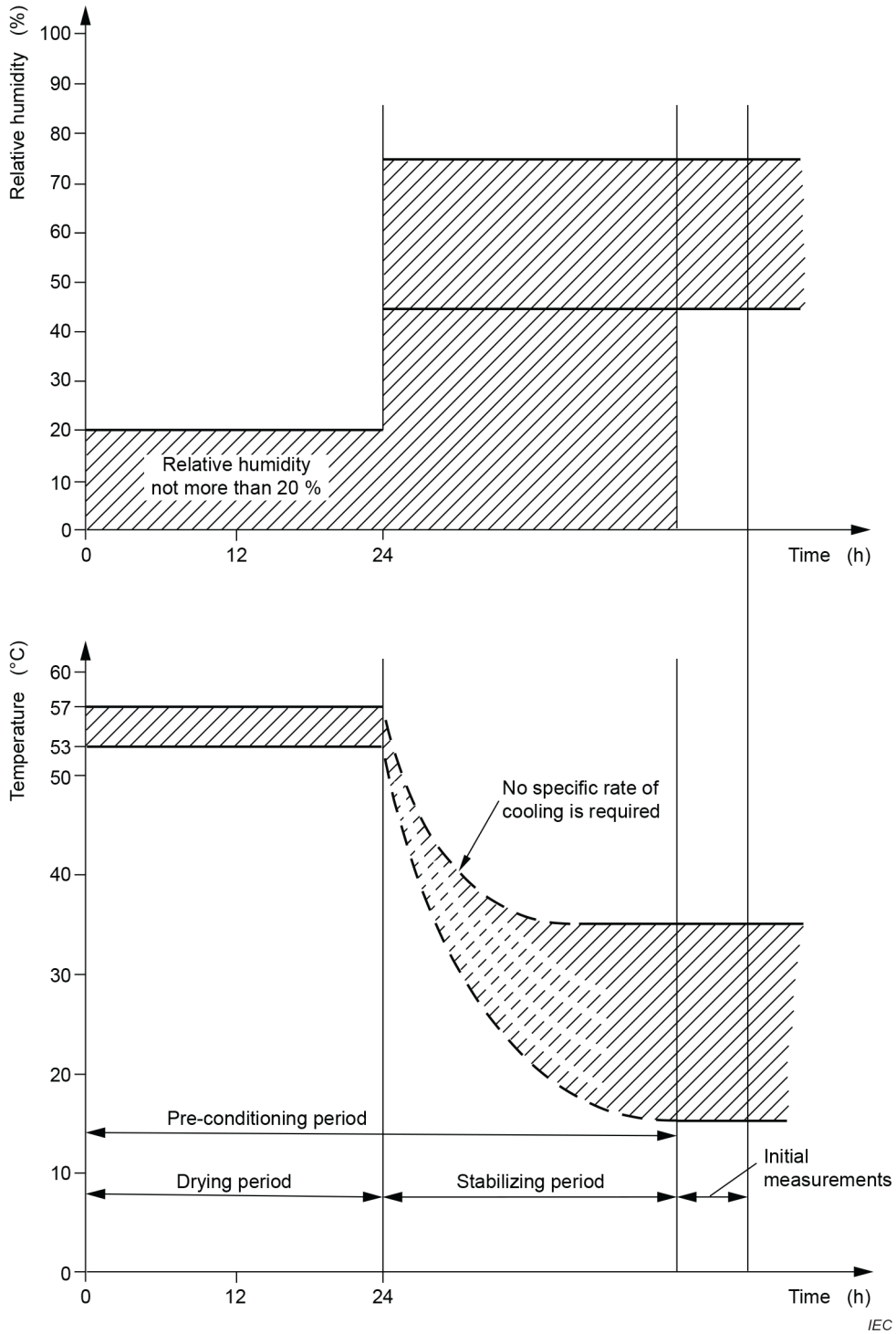

Figure 1 – Preconditioning

7.2 Initial measurements

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

7.3 Conditioning

The total temperature tolerance of ±2 K given in this document is intended to take account of absolute errors in the measurement, slow changes of temperature and temperature variations of the working space.

Documents
Document Sharing Hub
Full document details: IEC 60068-2-38 2021 RLV

NOTE This tolerance is valid for an empty test space during stabilized temperature/humidity conditions of the test. In some conditions, where the specimen has a negligible impact on the chamber control, the tolerances can still be valid for the chamber with specimen(s).

However, in order to maintain the relative humidity within the required tolerances, it is necessary to keep the temperature difference between any two points in the working space at any moment within narrower limits. The required humidity conditions will not be achieved if such temperature differences exceed 1 K. It may also be necessary to keep short-term fluctuations within ~~±0,5 K~~ these limits to maintain the required humidity.

The specimens shall be introduced into the humidity chamber, in the unpacked, switched-off, ready-for-use state, and mounted in the normal orientation, if this is known, or as otherwise specified and shall be subjected to 10 temperature/humidity cycles, each of 24 h duration.

During any five of the first nine of the above cycles after exposure to the humidity subcycle (~~points a) to f)~~ areas A to H in Figure 2), the specimens shall be subjected to cold. The position of the cold subcycles should be defined in the relevant specification.

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

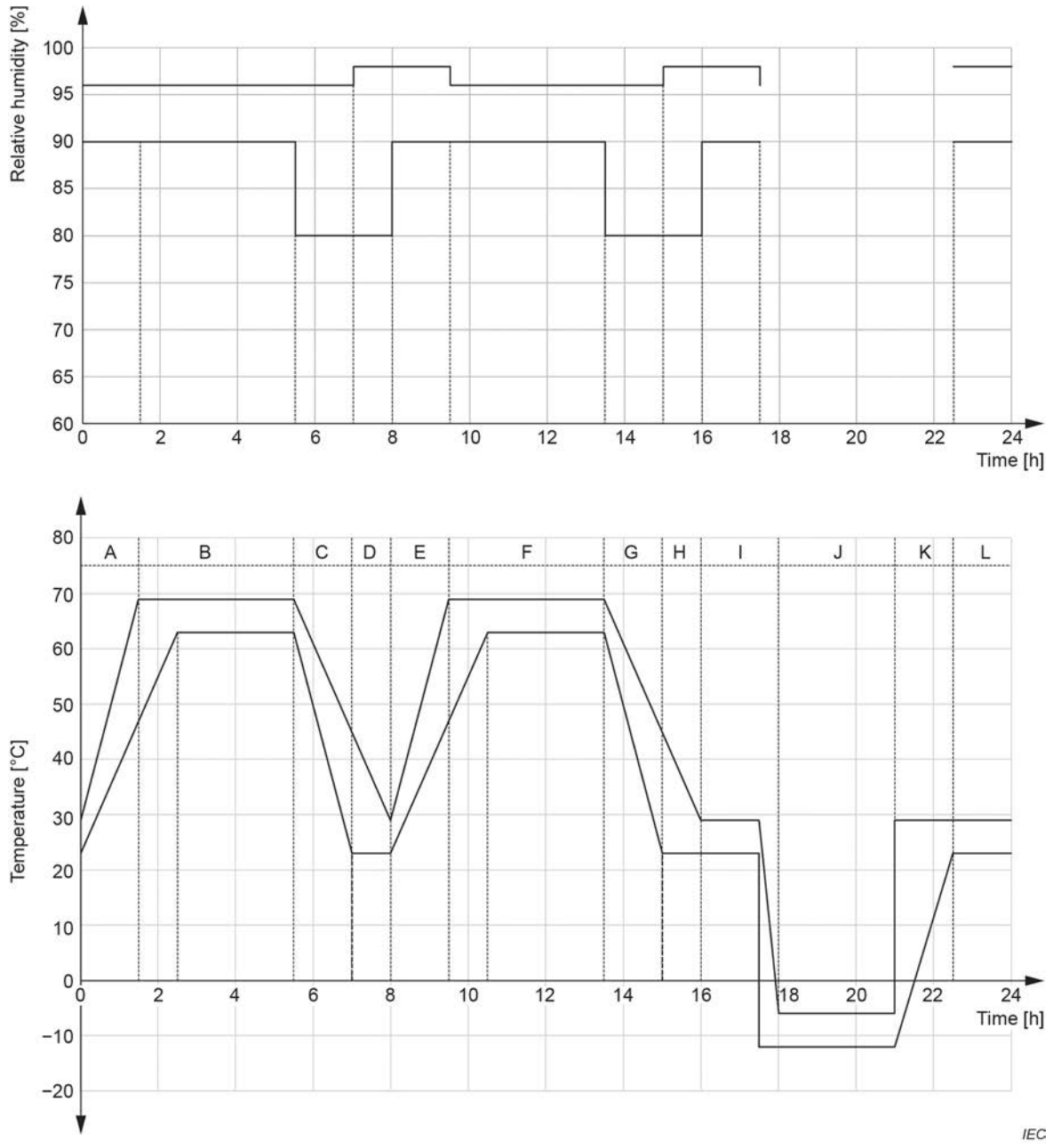

Figure 2 – Exposure to humidity followed by exposure to cold

This exposure may be performed either in the same chamber or in separate chambers. If separate chambers are used for the high-temperature/high-humidity and low-temperature subcycles of the test, the specimens should not be subjected to thermal shock conditions unless it is known that they are insensitive to this degree of thermal shock.

If a batch of specimens is subjected to thermal shock using the two chamber method and significant failures occur, a further batch shall be retested with gradual change of temperatures and shall be considered to have passed the test successfully if no significant failures occur under these conditions.

The remaining four of the first nine cycles shall be run without exposure to cold (see 7.4.3 and Figure 3). The humidity cycles ~~prescribed~~ specified are the same in all cases.

Documents
Document Sharing Hub
Full document details: IEC 60068-2-38 2021 RLV

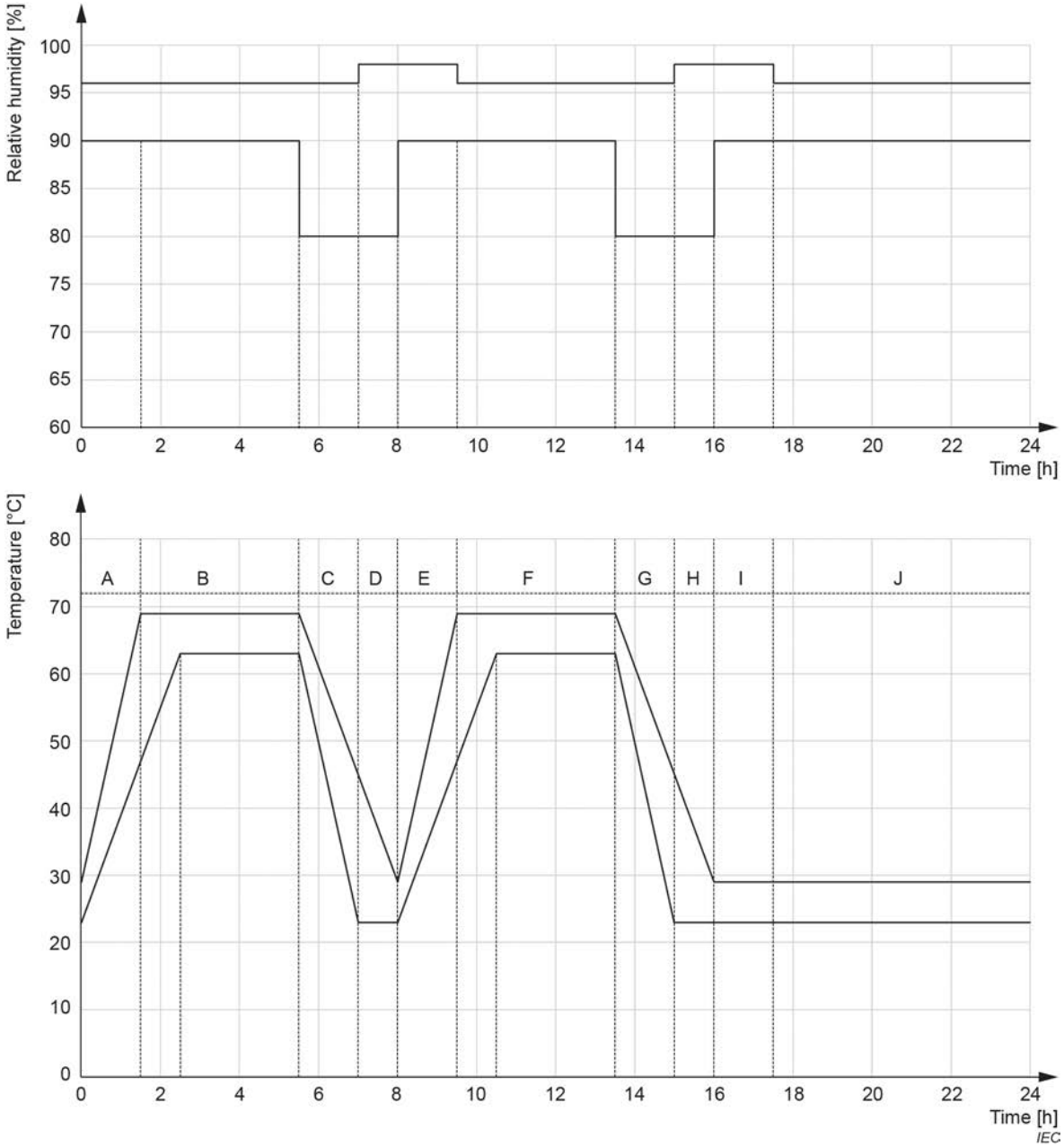

Figure 3 – Exposure to humidity not followed by exposure to cold

7.4 Test cycle

7.4.1 Description of temperature/humidity subcycle

The description of the temperature/humidity subcycles is applicable to all cycles (see Figure 2 and Figure 3).

NOTE 1 The dotted lines in Figure 2 and Figure 3 are for orientation purposes only, aiming to give a better understanding of the test cycle. They place no indication for the order of the set points for the test.

At "zero time" of every 24 h cycle, the chamber condition shall be controlled to a temperature of 25 °C ± 2 K and relative humidity at $\left(93^{+3}_{-3}\right)$ %.

Documents
Document Sharing Hub
Full document details: IEC 60068-2-38 2021 RLV

A The temperature of the chamber shall be continuously raised to 65 °C ± 2 K in a period of between 1,5 h and 2,5 h.

During this period, the relative humidity shall remain within the limits of $\left(93^{+3}_{-3}\right)$ %.

B The temperature and relative humidity in the chamber shall be maintained at 65 °C ± 2 K and $\left(93^{+3}_{-3}\right)$ % respectively, until 5,5 h after the start of the cycle.

C The temperature shall then be allowed to fall to 25 °C ± 2 K in a period of between 1,5 h and 2,5 h.

During this period, the relative humidity shall remain within the limits of 80 % to 96 %.

D Beginning 7 h after the start of the cycle, the relative humidity shall remain within the limits of 80 % to 98 %.

E Beginning 8 h after the start of the cycle, the temperature shall again be raised to 65 °C ± 2 K in a period of between 1,5 h and 2,5 h. During this period, the relative humidity shall be ~~(93 ± 3)~~ $\left(93^{+5}_{-3}\right)$ %.

F Beginning 9,5 h after the start of the cycle, the relative humidity shall remain within the limits of $\left(93^{+3}_{-3}\right)$ %.

The temperature and relative humidity in the chamber shall be maintained at 65 °C ± 2 K and $\left(93^{+3}_{-3}\right)$ % respectively, until 13,5 h after the start of the cycle.

G The temperature shall then be ~~drop~~ allowed to fall to 25 °C ± 2 K in a period of between 1,5 h and 2,5 h.

During this period, the relative humidity in the chamber shall remain within the limits of 80 % to 96 %.

H Beginning 15 h after the start of the cycle, the relative humidity shall remain within the limits of 80 % to 98 %.

I The chamber shall then continue to run at a stabilized temperature of 25 °C ± 2 K and relative humidity of ~~(93 ±3) % until the start of the cold subcycle or until the end of the 24 h cycle as appropriate~~ $\left(93^{+5}_{-3}\right)$ %.

7.4.2 Description of cold subcycle

This description is applicable to any five of the first nine cycles (see Figure 2).

I Following the completion of the temperature/humidity subcycle (~~points a) to f)~~ areas A to H in Figure 2), the chamber is maintained at a temperature of 25 °C ± 2 K and a relative humidity of ~~(93 ± 3)~~ $\left(93^{+5}_{-3}\right)$ % for a period of at least 1 h but not more than 2 h.

K The specimen shall then be exposed to cold by lowering the temperature of the chamber or transferring to a second chamber.

If the specimen is transferred from one chamber to another, the transfer should be completed within a period of 5 min. Beginning 17,5 h after the start of the cycle, the ambient temperature of the chamber shall be reduced to –10 °C ± 2 K. This temperature shall be reached 18 h after the start of the cycle.

Beginning 18 h after the start of the cycle, the temperature shall be maintained at −10 °C ± 2 K for a period of 3 h.

No requirement for humidity is ~~prescribed~~ specified during the entire cold subcycle.

L Beginning 21 h after the start of the cycle, the temperature shall be raised to 25 °C ± 2 K. This temperature shall be reached 22,5 h after the start of the cycle (see Figure 2).

If the specimen is transferred from one chamber to another, the transfer shall be completed within a period of 10 min to 15 min.

Documents
Document Sharing Hub
Full document details: IEC 60068-2-38 2021 RLV

M The temperature of the chamber shall be maintained at 25 °C ± 2 K until the 24 h cycle is completed. During this period, the relative humidity shall be ~~(93 ± 3)~~ $\left(93^{+5}_{-3}\right)$ %.

7.4.3 Description of 24 h cycles with no exposure to cold

This description is applicable to the remaining four of the first nine cycles (Figure 3).

Cycles which do not include a cold subcycle following the humidity/temperature subcycle are the same as described in 7.4.1, ~~except that under point g) the chamber shall be maintained at a temperature of 25 °C ±2 K and relative humidity of (93 ± 3) % until the 24 h cycle is completed~~ from A to H.

I Following the completion of the temperature/humidity subcycle (areas A to H in Figure 2), the chamber shall be maintained at a temperature of 25 °C ± 2 K and, beginning 16 h after the start of the cycle, the relative humidity shall be $\left(93^{+5}_{-3}\right)$ %.

J Beginning 17,5 h after the start of the cycle, the chamber shall then continue to run at a stabilized temperature of 25 °C ± 2 K and the relative humidity shall be kept within the limits of $\left(93^{+3}_{-3}\right)$ % until the end of the 24 h cycle.

NOTE This description is valid for Figure 3 (exposure to humidity not followed by exposure to cold) only.

7.4.4 Description of final cycle

In the final cycle, following the completion of the temperature and humidity subcycle, the chamber is maintained at a temperature of 25 °C ± 2 K and relative humidity of $\left(93^{+3}_{-3}\right)$ % for a period of 3,5 h after which the final measurements are made.

7.4.5 Intermediate measurements

In order to carry out measurements on energized specimen, the following parts of the constant phases of the test cycles shown in Figure 2 and Figure 3 can be used:

– area beginning 2,5 h after the test has started until 5,5 h after the test has started (time indicated by end of area B in Figure 2 and Figure 3);
– area beginning 10,5 h after the test has started until 18 h after the test has started (time indicated by end of area F in Figure 2 and Figure 3)

During operation, functional checks only should be carried out, as permanent operation of the specimen could interfere with the severity of the climatic stress applied to the specimen. Figure 4 and Figure 5 indicate the areas where these measurements can be carried out.

Documents
Document Sharing Hub
Full document details: IEC 60068-2-38 2021 RLV

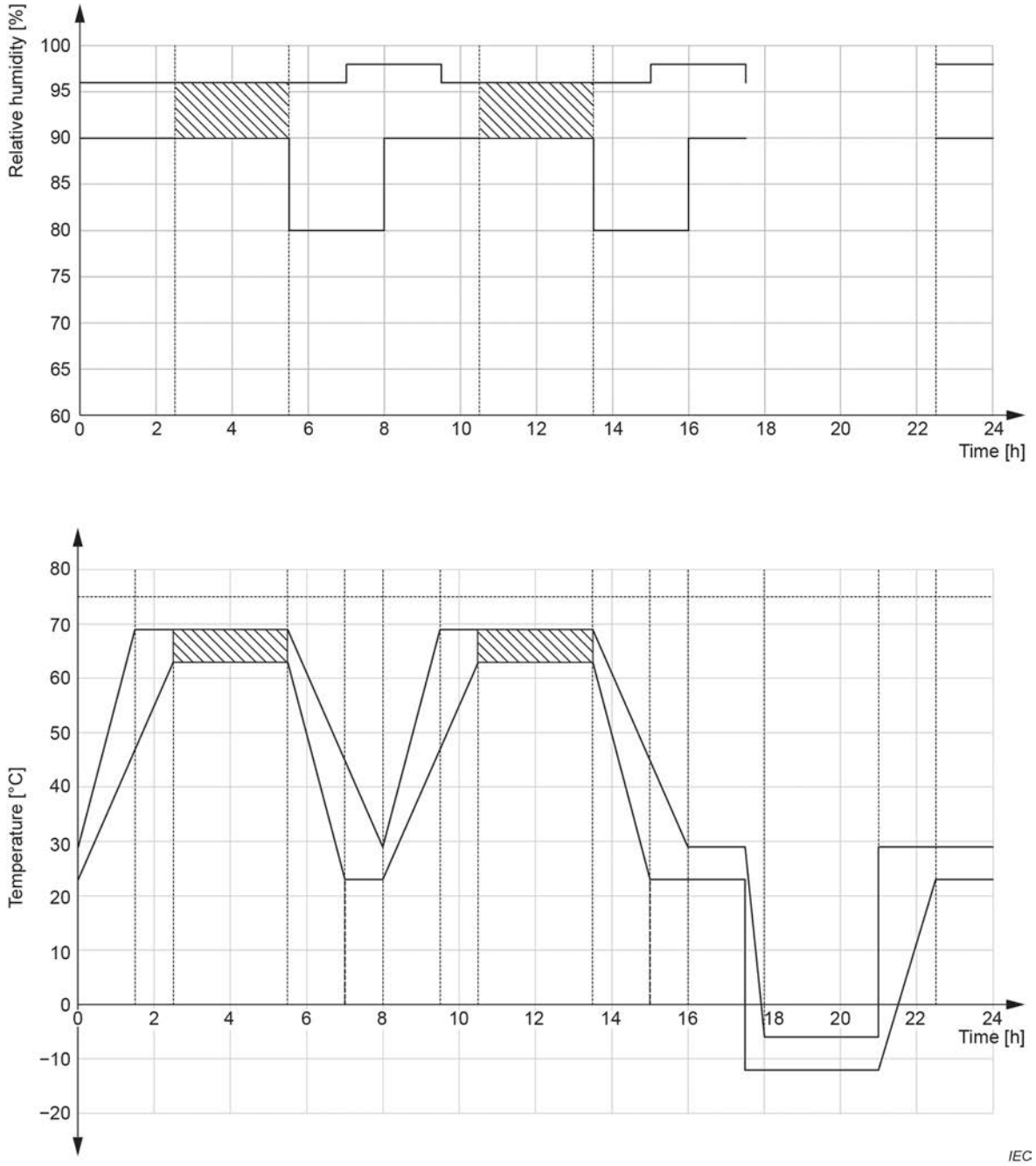

Figure 4 – Test times for intermediate operation of specimen – Exposure to humidity followed by exposure to cold

Documents
Document Sharing Hub
Full document details: IEC 60068-2-38 2021 RLV

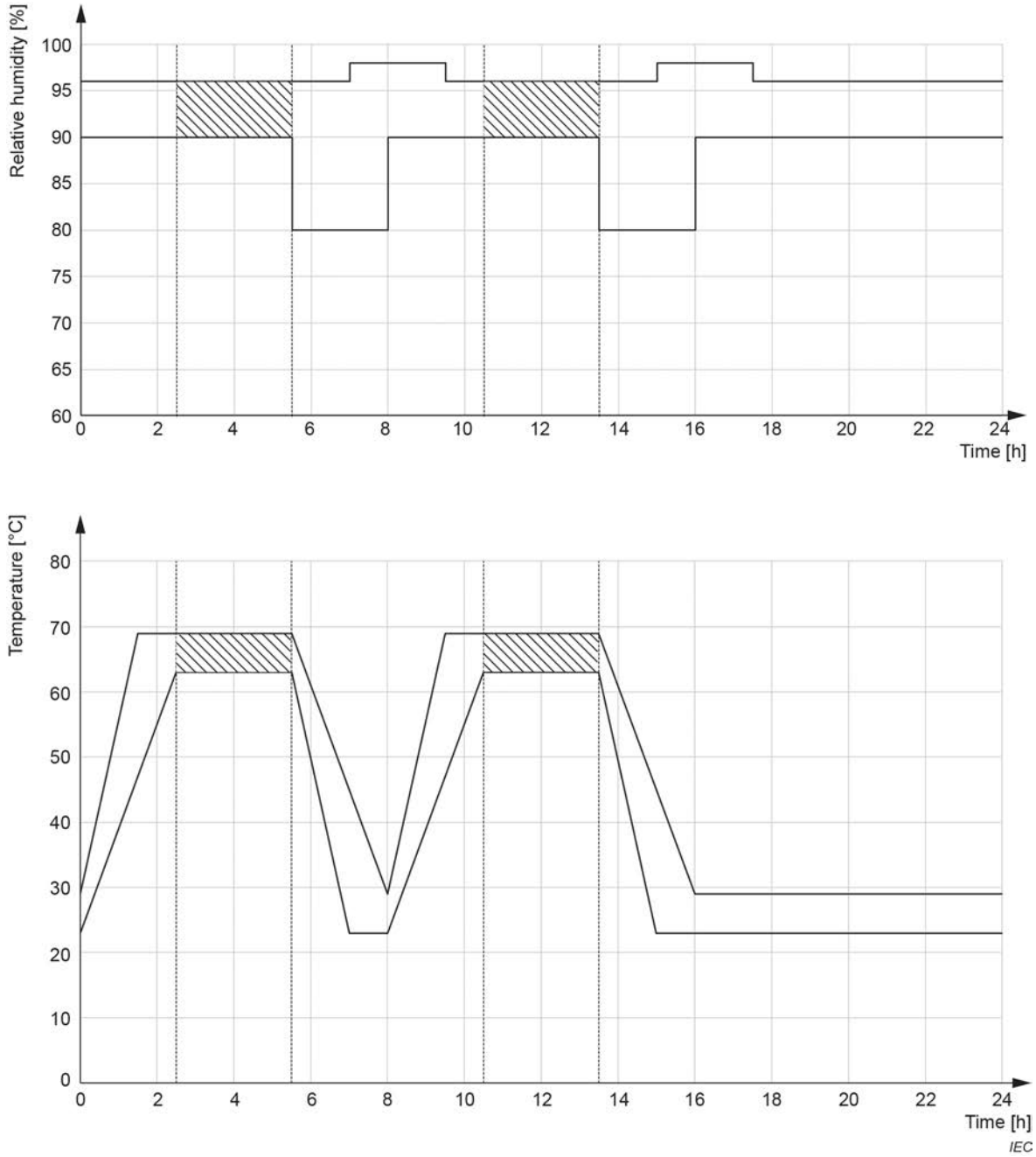

Figure 5 – Test times for intermediate operation of specimen – Exposure to humidity not followed by exposure to cold

7.5 Final measurements

7.5.1 Introductory remarks

Electrical and mechanical measurements may be made

a) at high humidity,

b) immediately upon removal from the chamber,

c) after a drying period, or

d) as required by the relevant specification.

It should be realized that many measurements taken under high humidity conditions are not directly comparable with those taken initially or after removal from the chamber.

Documents
Document Sharing Hub
Full document details: IEC 60068-2-38 2021 RLV

7.5.2 At high humidity

The measurements shall be made during the last two hours of the 3,5 h period referred to in ~~6.4.4~~ Figure 3.

The relevant specification shall specify the particular precautions to be followed in making measurements under conditions of high relative humidity, including the means to be adopted for the removal of surface water if this is necessary.

The specimen shall be removed from the chamber after all measurements have been completed.

7.5.3 Immediately upon removal from the chamber

On completion of the final cycle, the specimen shall be removed from the chamber and be kept at the laboratory ambient temperature.

If the initial measurements were made under conditions different from the laboratory ambient temperature, the same conditions shall be used for both sets of measurements.

Electrical and mechanical measurements, as specified, shall be made within a period of between 1 h and 2 h after removal from the chamber.

Measurements taken early in this time period may be repeated once only, later in the time period. The later reading will be used for failure determination.

7.5.4 After final drying

On completion of the final cycle, the specimen shall be removed from the chamber and shall be kept under standard atmospheric conditions for testing for a period of 24 h before the specified final measurements are made.

If the initial measurements were made under conditions other than standard atmospheric conditions for testing, the same conditions shall be used for both sets of measurements.

Measurements may be made during the 24 h period, but only measurements made at the end of the 24 h period shall be used for failure determination.

8 Information to be given in the relevant specification

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

a) type of test (subcycle);
b) preconditioning;
c) initial measurements;
d) details of mounting and supports;
e) number of cycles;
f) position of cold subcycles;
g) measurements and/or loading during conditioning;
h) recovery;
i) final measurements;
j) any deviation in procedure as agreed upon between customer and supplier.

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

9 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~~	~~(Z/AD)~~
~~e)~~	~~Purpose of test~~	~~(development, qualification, etc.)~~
~~f)~~	~~Test standard, edition~~	~~(IEC 60068-2-38, edition used)~~
~~g)~~	~~Relevant laboratory test procedure~~	~~(code and issue)~~
~~h)~~	~~Test specimen description~~	~~(drawing, photo, quantity build status, etc.)~~
~~i)~~	~~Test chamber identity~~	~~(manufacturer, model number, unique identity, etc.)~~
~~j)~~	~~Performance of test apparatus~~	~~(set point temperature control, air flow, etc.)~~
~~k)~~	~~Air velocity and direction~~	~~(air velocity and direction of incident air to the specimen)~~
~~l)~~	~~Uncertainties of measuring system~~	~~(uncertainties data)~~
~~m)~~	~~Calibration data~~	~~(last and next due date)~~
~~n)~~	~~Initial, intermediate and final measurements~~	~~(initial, intermediate and final measurements)~~
~~o)~~	~~Required severities~~	~~(from relevant specification)~~
~~p)~~	~~Test severities~~	~~(measuring points, data, etc.)~~
~~q)~~	~~Performance of test specimens~~	~~(results of functional tests, etc.)~~
~~r)~~	~~Observations during testing and actions taken~~	~~(any pertinent observations)~~
~~s)~~	~~Summary of test~~	~~(test summary)~~
~~t)~~	~~Distribution~~	~~(distribution list)~~

~~NOTE A test log should be written for the testing which can be attached to the report.~~

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	(Z/AD);
e)	Test standard, edition	(IEC 60068-2-38, edition used);
f)	Test specimen description	(drawing, photo, quantity build status, etc.);
g)	Test chamber identity	(unique identity of the chamber, e.g. internal Laboratory Identification number/code);
h)	Initial, intermediate and final measurements	(if performed by the test laboratory);
i)	Required severities	(from relevant specification);
j)	Test severities	(measuring points, data, etc.);
k)	Performance of test specimens	(results of functional tests, etc.);
l)	Observations during testing and actions taken	(any pertinent observations);
m)	Test results	(test summary, e.g. pass/fail decision).

In addition to the mandatory information the test report can include, for example:

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

n)	Purpose of test	(development, qualification, etc.);
o)	Relevant laboratory test procedure	(code and issue);
p)	Performance of test apparatus	(set point temperature control, air flow, etc.);
q)	Air velocity and/or direction	(air velocity and/or direction of incident air to the specimen);
r)	Uncertainties of chamber independent measuring system	(uncertainties data);
s)	Calibration data	(last and next due date).

A test log should be written for the testing which can be attached to the report.

Documents
Document Sharing Hub

Full document details: IEC 60068-2-38 2021 RLV

Annex A
(informative)

Supporting documentation for test sequence

A.1 General

In order to simplify creating test routines for operating climatic chambers, the test steps for each test procedure are given in Table A.1 to Table A.4.

A.2 Preconditioning

Table A.1 – Relative humidity tolerances

Test step	Time h	Lower limit %	Upper limit %
1	0	0	20
2	24	45	75
3	48[a]	45	75
[a] Can be extended if necessary.			

Table A.2 – Temperature tolerances

Test step	Time h	Lower limit °C	Upper limit °C
1	0	53	57
2	24	53	57
3	48[a]	$f(t) = -0{,}000\,006\,258\,71\,t^5 + 0{,}001\,255\,169\,t^4 - 0{,}102\,362\,894\,t^3 + 4{,}293\,766\,092\,t^2 - 93{,}907\,963\,78\,t + 882{,}047\,291\,3$	$f(t) = -0{,}000\,003\,441\,6\,t^5 + 0{,}000\,746\,803\,t^4 - 0{,}066\,182\,76\,t^3 + 2{,}997\,420\,635\,t^2 - 69{,}342\,126\,98\,t + 689{,}24$
[a] Can be extended if necessary.			

Documents
Document Sharing Hub
Full document details: IEC 60068-2-38 2021 RLV