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INTERNATIONAL STANDARD

Liquid crystal display devices –
Part 10-2: Environmental, endurance and mechanical test methods – Environmental and endurance

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LIQUID CRYSTAL DISPLAY DEVICES –

Part 10-2: Environmental, endurance and mechanical test methods – Environmental and endurance

FOREWORD

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International Standard IEC 61747-10-2 has been prepared by IEC technical committee 110: Electronic display devices.

This first edition of IEC 61747-10-2 cancels and replaces Clauses 1 and 3 of the first edition of IEC 61747-5 published in 1998. This edition constitutes a technical revision.

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

a) Examples of the test conditions have been added to each test method;

b) References cited have been updated.

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

CDV	Report on voting
110/528/CDV	110/575A/RVC

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 61747 series, published under the general title *Liquid crystal display devices*, can be found on the IEC website.

NOTE It is intended that the other clauses of IEC 61747-5:1998 will be replaced by new parts in the IEC 61747 series. The details of the intended changes are given in Annex D of IEC 61747-30-1:2012.

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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

LIQUID CRYSTAL DISPLAY DEVICES –

Part 10-2: Environmental, endurance and mechanical test methods – Environmental and endurance

1 Scope and object

This part of IEC 61747 lists test methods applicable to liquid crystal display devices. It takes into account, wherever possible, the environmental test methods outlined in IEC 60068.

NOTE Devices include cells and modules.

The object of this standard is to establish uniform preferred test methods with preferred values for stress levels for judging the environmental properties of liquid crystal display devices.

In case of contradiction between this standard and a relevant specification, the latter should govern.

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 (all parts), *Environmental testing*

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 60068-2-5, *Environmental testing – Part 2-5: Tests – Test Sa: Simulated solar radiation at ground level and guidance for solar radiation testing*

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

IEC 60068-2-14:1984, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

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

IEC 60068-2-38:2009, *Environmental testing – Part 2-38: Tests – Test Z/AD: Composite temperature/humidity cyclic test*

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

IEC 60747 (all parts), *Semiconductor devices*

IEC 60747-1, *Semiconductor devices – Part 1: General*

IEC 60748-1, *Semiconductor devices – Integrated circuits – Part 1: General*

ISO 18909:2006, *Photography – Processed photographic colour films and paper prints – Methods for measuring image stability*

3 Terms, definitions and symbols

For the purposes of this standard, the terms, definitions and symbols given in IEC 60068, IEC 60747, IEC 60748-1 and IEC 61747-1 apply.

4 Standard atmospheric conditions for measurements and tests:

Unless otherwise specified, all tests and measurements shall be carried out under standard atmospheric conditions for testing:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 85 % RH, where appropriate

Air pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar)

The absolute humidity of the atmosphere shall not exceed 22 g/m^3.

5 Test methods

5.1 General

The choice of the appropriate tests depends on the type of devices. The relevant specification shall state which tests are applicable. Regarding the change of temperature, test Na, specified in IEC 60068-2-14, is applicable.

5.2 Rapid change of temperature: two-chamber method

This test shall be in accordance with test Na, with the following specific requirements:

– the absolute humidity of the atmosphere shall not exceed 20 g/m^3;
– the lower temperature T_A shall be specified in the relevant specification and shall be chosen from the test temperature of Table 1;
– the higher temperature T_B shall be specified in the relevant specification and shall be chosen from the test temperature of Table 2;

Table 1 – Low test temperature

Low temperature T_A °C		
–50 ± 3	–30 ± 3	–10 ± 3
–45 ± 3	–25 ± 3	–5 ± 3
–40 ± 3	–20 ± 3	0 ± 3
–35 ± 3	–15 ± 3	

Table 2 – High test temperature

High temperature T_B °C		
+100 ± 2	+75 ± 2	+50 ± 2
+95 ± 2	+70 ± 2	+45 ± 2
+90 ± 2	+65 ± 2	+40 ± 2
+85 ± 2	+60 ± 2	+35 ± 2
+80 ± 2	+55 ± 2	+30 ± 2

– the exposure time t_1 of each of the two temperatures depends upon the thermal capacity of the device. It shall be 3 h, 2 h, 1 h, 30 min or 10 min as specified in the relevant specification. Where no exposure period is prescribed in the relevant specification it is understood to be 3 h;

– t_2 is the time from unloading from one chamber to loading to the other chamber. The transition time should be:

2 min to 3 min;

20 s to 30 s;

less than 10 s;

– the first cycle comprises the two exposure times t_1 and the two transition times t_2 (see Figure 1);

– the number of cycles shall be 5, 10, 50, 100, 200 unless otherwise specified in the relevant specification;

– initial measurements:

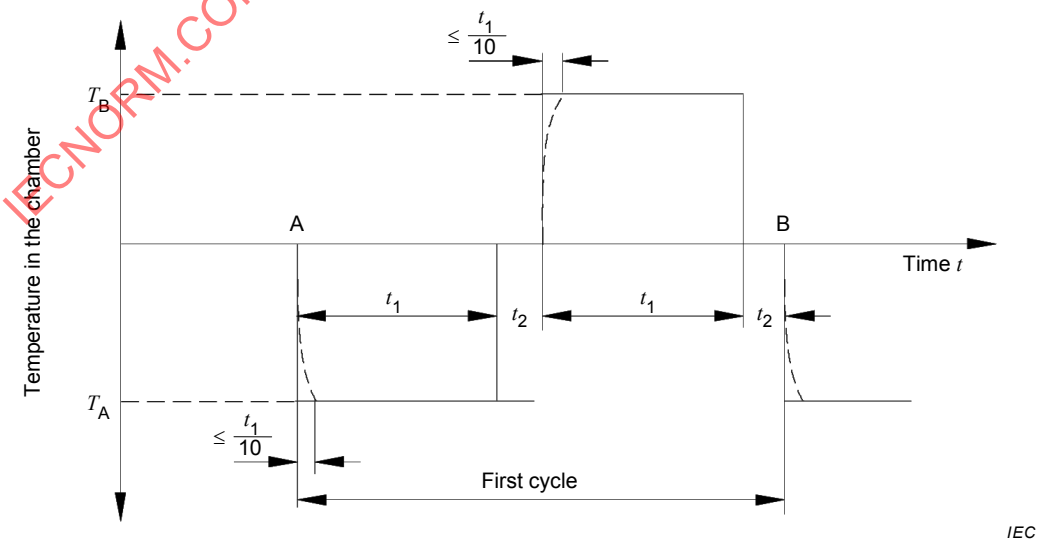
an external visual examination;

mechanical, electrical and optical tests: as given in the relevant specification;

– final measurements:

an external visual examination;

mechanical, electrical, and optical tests: as specified at the initial measurements and in the relevant specification.



A = start of first cycle

B = end of first cycle and start of second cycle

NOTE The dotted curve is explained in 1.3.1.5 of IEC 60068-2-14:1984.

Figure 1 – Temperature profile for the two-chamber method

Example test conditions (for thermal shock test):

T_a = -40 ºC, T_b = +85 ºC, t_1 = 30 min, t_2 = 3 min, 50 cycles

T_a = -40 ºC, T_b = +85 ºC, t_1 = 30 min, t_2 = 3 min, 100 cycles

T_a = -30 ºC, T_b = +80 ºC, t_1 = 30 min, t_2 = 3 min, 100 cycles

5.3 Specified change rate of temperature: one-chamber method

This test shall be in accordance with test Nb, with the following specific requirements:

– the absolute humidity of the atmosphere shall not exceed 20 g/m^3;

– the lower temperature T_A shall be specified in the relevant specification and shall be chosen from the test temperature of Table 3;

– the higher temperature T_B shall be specified in the relevant specification and shall be chosen from the test temperature of Table 4;

Table 3 – Low test temperature

Low temperature T_A °C		
–50 ± 3	–30 ± 3	–10 ± 3
–45 ± 3	–25 ± 3	–5 ± 3
–40 ± 3	–20 ± 3	0 ± 3
–35 ± 3	–15 ± 3	

Table 4 – High test temperature

High temperature T_B °C		
+100 ± 2	+75 ± 2	+50 ± 2
+95 ± 2	+70 ± 2	+45 ± 2
+90 ± 2	+65 ± 2	+40 ± 2
+85 ± 2	+60 ± 2	+35 ± 2
+80 ± 2	+55 ± 2	+30 ± 2

– the exposure time t_1 of each of the two temperatures depends upon the heat capacity of the device. It shall be 3 h, 2 h, 1 h, 30 min or 10 min, as specified in the relevant specification. Where no exposure period is prescribed in the relevant specification it is understood to be 3 h;

– the following procedure constitutes one cycle (see Figure 2); the temperature of the chamber shall be lowered or raised at a rate which, averaged over a period of not more than 5 min, is either (1 ± 0,2) °C/min, (3 ± 0,6) °C/min or (5 ± 1) °C/min, unless otherwise specified in the relevant specification;

– the number of cycles shall be 2, unless otherwise specified in the relevant specification;

– initial measurements:

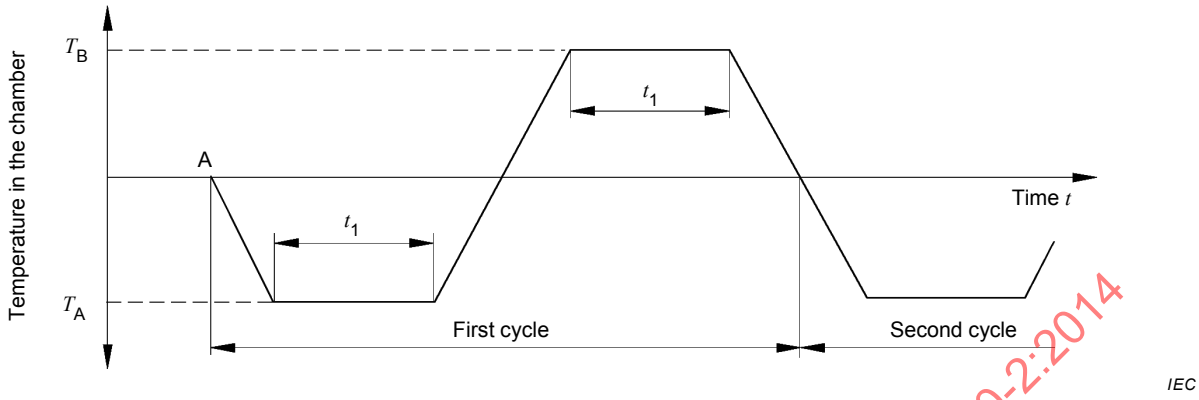
  an external visual examination;

  mechanical, electrical and optical tests: as given in the relevant specification;

– final measurements:

  an external visual examination;

mechanical, electrical and optical tests: as specified at the initial measurements and in the relevant specification.



A = start of first cycle

Figure 2 – Temperature profile for the one-chamber method

5.4 Storage (at high temperature)

Test B, described in IEC 60068-2-2 is applicable.

This test shall be in accordance with test Bb, with the following specific requirements:

– the temperature shall be specified in the relevant specification. The values shall be selected from those given below:

  +100 °C ± 2 °C

  +95 °C ± 2 °C

  +90 °C ± 2 °C

  +85 °C ± 2 °C

  +80 °C ± 2 °C

  +75 °C ± 2 °C

  +70 °C ± 2 °C

  +65 °C ± 2 °C

  +60 °C ± 2 °C

  +55 °C ± 2 °C

  +50 °C ± 2 °C

  +45 °C ± 2 °C

  +40 °C ± 2 °C

  +35 °C ± 2 °C

  +30 °C ± 2 °C

– the duration shall be selected from the values given below, as specified in the relevant specification:

  2 h

  16 h

  24 h

  48 h

  72 h

96 h

120 h

192 h

240 h

300 h

500 h

1 000 h

– the absolute humidity of the atmosphere should not exceed 20 g/m^3 (corresponding approximately to 50 % relative humidity at 35 °C). When testing is performed at a temperature lower than 35 °C, the relative humidity shall not exceed 50 %.

Example test conditions (for high temperature storage):

80°C, 240 h

60°C, 240 h

60°C, 500 h

5.5 Storage (at low temperature)

Test A of IEC 60068-2-1 is applicable.

This test shall be in accordance with test Ab, with the following specific requirements:

– the temperature shall be specified in the relevant specification. The values shall be selected from those given below:

–50 °C ± 3 °C

–45 °C ± 3 °C

–40 °C ± 3 °C

–35 °C ± 3 °C

–30 °C ± 3 °C

–25 °C ± 3 °C

–20 °C ± 3 °C

–15 °C ± 3 °C

–10 °C ± 3 °C

–5 °C ± 3 °C

0 °C ± 3 °C

– the duration shall be selected from the values given below, as specified in the relevant specification:

2 h

16 h

24 h

48 h

72 h

96 h

120 h

192 h

240 h

300 h

500 h

1 000 h

Example test conditions (for low temperature storage):

–20 °C, 240 h

–20 °C, 500 h

–30 °C, 240 h

5.6 Low air pressure

Test M, specified in IEC 60068-2-13, is applicable.

5.7 Damp heat, steady state

Test Cab, specified in IEC 60068-2-78, is applicable with the following specific requirements:

– the temperature and humidity shall be selected from Table 5 and specified in the relevant specification;

Table 5 – Conditions of temperature and humidity

Temperature °C	Humidity %
+40 ± 2	93^{+2}_{-3}
+50 ± 2	
+60 ± 2	
+70 ± 2	
+80 ± 2	
+85 ± 2	+85 ± 5

– the duration shall be selected from the values given below, as specified in the relevant specification:

2 h

16 h

24 h

48 h

72 h

96 h

120 h

192 h

240 h

300 h

500 h

1 000 h

Example test conditions (for damp heat, steady state):

40 ºC, 93% RH, 500 h

60 ºC, 93% RH, 500 h

5.8 Damp heat, cyclic (12 + 12-hour cycle)

Test Db, specified in IEC 60068-2-30, is applicable.

Example test conditions (for damp heat, cyclic):

40 ºC, 10 cycles

60 ºC, 5 cycles

5.9 Composite temperature/humidity cyclic test

Test Z/AD, specified in IEC 60068-2-38, is applicable, with the following specific requirements:

– the duration of each condition shall not depart from the specified value by more than ±10 min;

– when the exposure to moisture, followed by cold, is performed in one chamber, the temperature shall be lowered from (25 ± 2) °C to (–10 ± 2) °C for a period of not more than 1,5 h. The specimen shall be held at low temperature for a period of 3 h;

– relative humidity and temperature conditions of the preconditioning shall be controlled as shown in Figure 3;

– relative humidity and temperature conditions of the conditioning shall be controlled as shown in Figure 4 (with exposure to cold) or Figure 5 (without exposure to cold);

– description of temperature/humidity subcycle.

The high temperature condition shall be selected as specified in the relevant specification.

a) The temperature of the chamber shall be continuously raised to the specified high temperature in a period of between 1,5 h and 2,5 h. During this period, the relative humidity shall remain within the limits (93 ± 3) %.

b) The temperature and relative humidity in the chamber shall be maintained at the specified high temperature and (93 ± 3) %, respectively, during 5,5 h after the start of the cycle.

c) The temperature shall be allowed to fall to (25 ± 2) °C in a period of between 1,5 h and 2,5 h. During this period, the relative humidity shall remain within the limits 80 % to 96 %.

d) Beginning 8 h after the start of the cycle, the temperature shall be continuously raised to the specified high temperature in a period of between 1,5 h and 2,5 h. During this period, the relative humidity shall be (93 ± 3) %.

e) The temperature and relative humidity in the chamber shall be maintained at the specified high temperature and (93 ± 3) %, respectively, until 13,5 h after the start of the cycle.

f) The temperature shall be allowed to fall to (25 ± 2) °C in a period of between 1,5 h and 2,5 h. During this period, the relative humidity shall remain within the limits 80 % to 96 %.

g) The chamber shall continue to run at a stabilized temperature of (25 ± 2) °C and relative humidity of (93 ± 3) % until the start of the cold subcycle or until the end of the 24 h cycle, as appropriate.

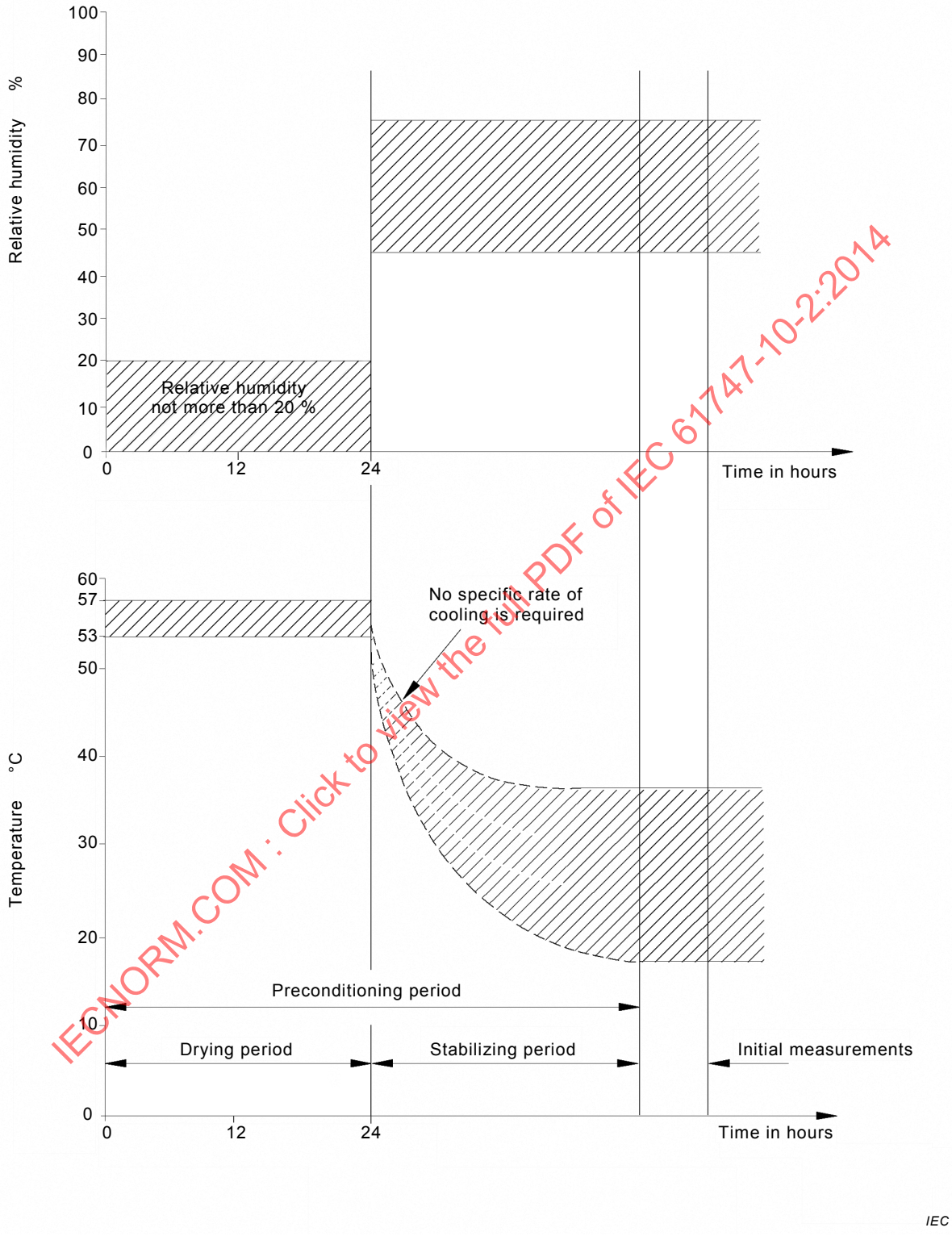
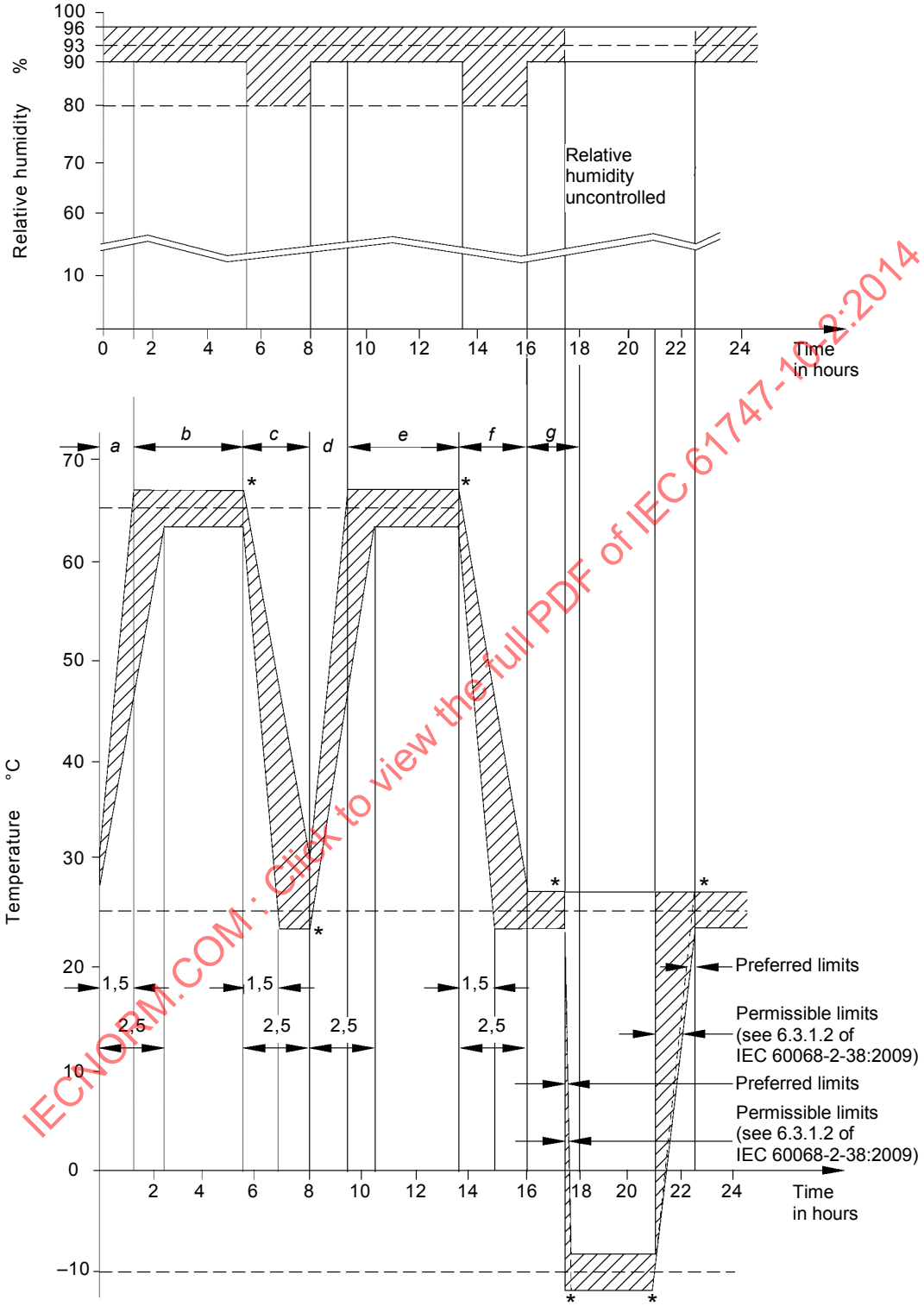


Figure 3 – Preconditioning



* Tolerance on time at these points ± 5 min.

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Figure 4 – Conditioning – Exposure to humidity followed by exposure to cold

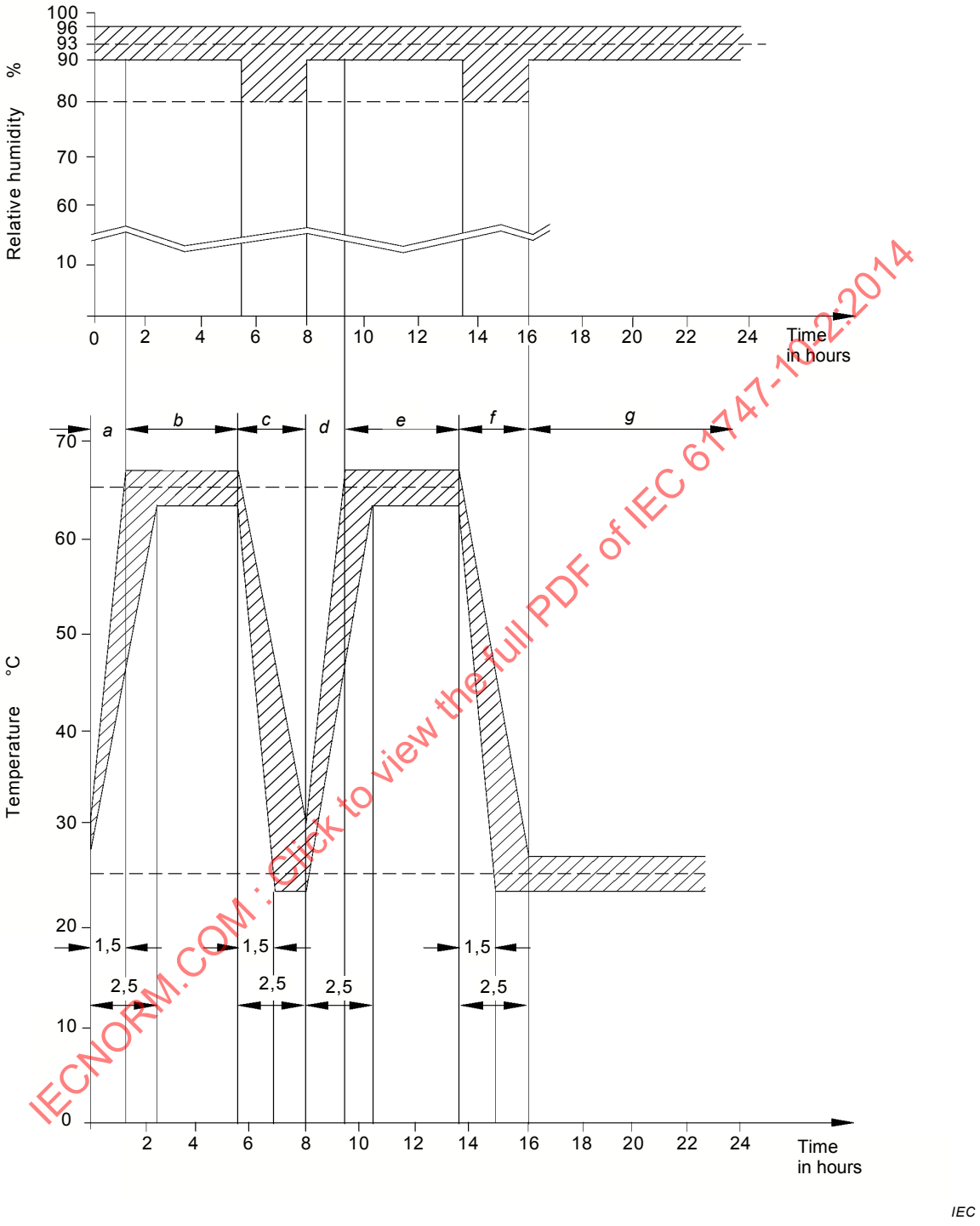

Figure 5 – Conditioning – Exposure to humidity not followed by exposure to cold

5.10 Light exposure

5.10.1 Simulated solar radiation at ground level

Test Sa, specified in IEC 60068-2-5, is applicable.

5.10.2 Simulated indoor daylight through window glass

The test method described in 5.6 of ISO 18909:2006 shall be used.