

TECHNICAL REPORT



**Durability test methods for electronic displays –
Part 2-12: Environmental tests – Environmental conditions of use, storage
and transportation of electronic displays**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 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 Varembe
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 It also gives information on projects, replaced and withdrawn publications.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.

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 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

TECHNICAL REPORT



**Durability test methods for electronic displays –
Part 2-12: Environmental tests – Environmental conditions of use, storage
and transportation of electronic displays**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.120

ISBN 978-2-8322-7802-4

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

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
4 Overview	8
4.1 Use cases and stress factors	8
4.2 Test conditions in existing standards	9
5 Indoor.....	9
5.1 General.....	9
5.2 Temperature and humidity	9
5.2.1 Consumer homes.....	9
5.2.2 Office and commercial buildings	10
5.3 Light	12
5.3.1 Consumer homes.....	12
5.3.2 Office and commercial buildings	14
6 Outdoor	15
6.1 General.....	15
6.2 Temperature and humidity	15
6.3 Light	18
7 Vehicles	20
7.1 General.....	20
7.2 Temperature	20
7.3 Light	21
8 Transportation and storage.....	22
8.1 General.....	22
8.2 Temperature and humidity	23
Annex A (informative) Test conditions in standards dealing with electronic displays.....	27
A.1 IEC standards on electronic displays related to environmental tests.....	27
A.2 High-temperature testing.....	27
A.3 Low-temperature testing	28
A.4 Damp heat testing.....	29
A.5 Other testing	30
Annex B (informative) IEC 60068 series – Standards of environmental testing for electrotechnical products	31
B.1 General.....	31
B.2 Related standards of the IEC 60068 series	31
Bibliography.....	32
Figure 1 – Range of year-round temperature and humidity in Sapporo (left) and Okinawa (right) in Japan	10
Figure 2 – Examples of relative spectrum distribution of daytime in consumer homes	12
Figure 3 – Examples of relative spectrum distribution of lamps in consumer homes	13
Figure 4 – Comparison of the relative spectrum distribution of various light sources used in light stability testing.....	13

Figure 5 – Histogram of average daytime light levels in consumer homes around the world.....	14
Figure 6 – Example of year-round data, New York (United States)	16
Figure 7 – Temperature versus humidity maps of four climatic divisions.....	17
Figure 8 – Worldwide deviation of temperature and relative humidity	18
Figure 9 – Schematic diagram of solar radiation outdoors	20
Figure 10 – Temperature trends in a car left in the sun in summer	21
Figure 11 – Light intensity inside a car cabin as a percentage of the outside light intensity	22
Figure 12 – Spectral transmittance examples of automobile windows.....	22
Figure 13 – Temperature and humidity trends of marine transportation	23
Table 1 – Documents related to environmental tests for electronic displays	7
Table 2 – Overview of the stress factors for each type of use case	9
Table 3 – Collection of condition data of consumer homes in eight cities	10
Table 4 – Results of temperature and relative humidity of consumer homes.....	10
Table 5 – Examples of guidelines for temperature and humidity	11
Table 6 – Rate of conformity to the guidelines for temperature and humidity in Japan.....	11
Table 7 – Summary of light levels in ISO 8995-1 [15]and JIS Z 9110 [16]	14
Table 8 – Typical conditions for commercial prints in ISO TS 21139-1 [17]	14
Table 9 – Forty-eight cities from each climatic division.....	16
Table 10 – Boundary data of deviation around the world	18
Table 11 – Year-round average data of global radiation from 21 countries	19
Table 12 – Summary of temperature data in cars left in the sun	21
Table 13 – Survey results of marine transportation	24
Table 14 – Results of survey of transportation by land	25
Table 15 – Cargo left in a parked vehicle or stored in a warehouse.....	25
Table 16 – Examples of the temperature in air cargo compartments	26
Table 17 – Temperature, humidity and air pressure during air shipment.....	26
Table A.1 – IEC standards for electronic displays related to environmental tests	27
Table A.2 – Testing conditions for storage at high temperature	28
Table A.3 – Testing conditions for operation at high temperature	28
Table A.4 – Testing conditions for storage at low temperature	28
Table A.5 – Testing conditions for operation at low temperature	29
Table A.6 – Testing conditions for storage under damp heat	29
Table A.7 – Testing conditions for operation under damp heat	30
Table B.1 – Standards of IEC 60068 series.....	31

INTERNATIONAL ELECTROTECHNICAL COMMISSION

DURABILITY TEST METHODS FOR ELECTRONIC DISPLAYS –**Part 2-12: Environmental tests – Environmental conditions of use, storage and transportation of electronic displays**

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.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 63211-2-12, which is a technical report, has been prepared by IEC technical committee 110: Electronic displays.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
110/1102/DTR	110/1122A/RVDTR

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

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

A list of all parts in the IEC 63211 series, published under the general title *Durability test methods for electronic displays*, can be found on the IEC website.

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

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

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

INTRODUCTION

The IEC 63211 series covers the durability test methods of electronic displays and related components. This series describes the evaluation of resistance of two or more electronic displays and their related components to environmental stress, mechanical stress, a combination of environmental and mechanical stress, contact with chemicals, and other stresses.

This part of IEC 63211 focuses on environmental aspects and describes the environmental conditions of displays, when in use, stored or transported.

The main environmental factors that influence the durability of electronic displays are the temperature and relative humidity of the air and the level of light exposure. These factors have been described in the IEC 60068 series as the general conditions of environmental testing for electrotechnical products. However, in the IEC 60068 series, the conditions are merely listed and cover an extremely wide range of diverse values. For example, the conditions of dry heat temperature are stipulated in IEC 60068-2-2 [1]¹ as the range from 30 °C to 1 000 °C. They are merely listed as a series of temperature values such as, (30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 100, 125, 155, 175, 200, 250, 315, 400, 500, 630, 800 and 1 000) °C. Temperatures of several hundreds of degrees are too severe to maintain the original functions of most electronic displays, and so these elevated temperatures have no valuable meaning as a test condition.

Therefore, environmental tests for electronic displays have been documented for each type of technology, such as LCD, PDP and OLED, as shown in Table 1. They were originally created using the IEC 60068 series documents as a reference, and some modifications were introduced to be suitable for electronic displays. For example, the conditions of the dry heat temperature test are limited in IEC 61747-10-2 [2] to the range from 30 °C to 100 °C.

The environmental test documents for electronic displays summarised in Table 1 have two problems. The first is that each document focuses on a specific display technology. The second is that the conditions are merely listed so users are required to choose several conditions that are fit for their intended purpose.

Most environmental stresses are not very different, even if the technologies under test are different. The test methods and test conditions should be discussed, and the most appropriate test should be chosen based on the application and the intended usage, rather than the technology used in the displays.

This document describes the data and information on the environmental conditions relevant to how electronic displays are actually used, stored or transported in various use profiles. They are intended to be used as a reference when the test conditions are determined. Even though the test conditions should be harsher than the actual conditions, in order to accelerate the tests, it is important to consider the actual conditions when the accelerated test conditions are discussed.

¹ Numbers in square brackets refer to the Bibliography.

Table 1 – Documents related to environmental tests for electronic displays

IEC document (scope)	Title	Status and date of publication
IEC 61747-10-2 [2] (LCD)	Liquid crystal display devices – Part 10-2: Environmental, endurance and mechanical test methods – Environmental and endurance	Edition 1.0 2014-09-03
IEC 61988-4-1 [3] (PDP)	Plasma display panels – Part 4-1: Environmental testing methods – Climatic and mechanical	Edition 1.0 2015-03-25
IEC 62341-5 [4] (OLED)	Organic light emitting diode (OLED) displays – Part 5: Environmental testing methods	Edition 1.0 2009-11-20
IEC 62679-4-2 [5] (EPD)	Electronic paper displays – Part 4-2: Environmental test methods	Edition 1.0 2016-08-29
IEC 62715-6-2 [6] (FDD)	Flexible display devices – Part 6-2: Environmental testing methods	Edition 1.0 2017-05-24
IEC 62908-13-10 [7] (TID)	Touch and interactive displays – Part 13-10: Reliability test methods of touch displays – Environmental durability test methods	Edition 1.0 2016-11-25

DURABILITY TEST METHODS FOR ELECTRONIC DISPLAYS –

Part 2-12: Environmental tests – Environmental conditions of use, storage and transportation of electronic displays

1 Scope

This part of IEC 63211 provides data and information on the environmental conditions when electronic displays are used, stored and transported.

This document covers the temperature, relative humidity and light of the environment of electronic displays.

The information provided by this document is related to the following electronic displays:

- a) indoor displays for consumer homes and offices, such as TVs or PC monitors,
- b) indoor displays for commercial applications, such as signage and show cases,
- c) mobile displays, such as smartphones, tablets, e-books and mobile PCs,
- d) wearable displays, such as eyewear displays and smart watches,
- e) in-vehicle displays, and
- f) outdoor displays, such as signage for public information and advertising.

2 Normative references

There are no normative references in this document.

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>

4 Overview

4.1 Use cases and stress factors

Stress factors on electronic displays vary according to the type of use. An overview of the stress factors in each use case is shown in Table 2. The number of “+” symbols indicates how serious the stress factor is in each case; “+++++” means seriously affected, “+” means slightly affected and “-” means not affected. “Duration” indicates the typical length of time of exposition to the stress factor, “long” means several years to twenty years, “middle” means several months to a few years and “short” means several days to a few months.