

INTERNATIONAL STANDARD



**Electronic paper displays –
Part 4-2: Environmental test methods**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2016 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
Fax: +41 22 919 03 00
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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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 It also gives information on projects, replaced and withdrawn publications.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 also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - www.iec.ch/glossary

65 000 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.

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: csc@iec.ch.

INTERNATIONAL STANDARD



**Electronic paper displays –
Part 4-2: Environmental test methods**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.120; 31.260

ISBN 978-2-8322-3607-9

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

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references.....	6
3 Terms and definitions	6
4 Measuring conditions.....	7
4.1 Standard measuring environmental conditions	7
4.2 Standard atmospheric conditions for reference measurements and tests	7
4.3 Recovery conditions	8
4.3.1 General	8
4.3.2 Controlled recovery conditions	8
4.3.3 Recovery procedure.....	8
5 Measuring methods of environmental properties.....	9
5.1 High temperature storage test	9
5.1.1 Purpose.....	9
5.1.2 Storage conditions	9
5.2 Low temperature storage test	9
5.2.1 Purpose.....	9
5.2.2 Storage conditions	9
5.3 Temperature shock test – Two chambers.....	9
5.3.1 Purpose.....	9
5.3.2 Storage conditions	9
5.4 Specified change rate test of temperature – One chamber	10
5.4.1 Purpose.....	10
5.4.2 Storage conditions	11
5.5 Combination temperature/humidity test.....	12
5.5.1 Purpose.....	12
5.5.2 Storage conditions	12
5.6 Combination temperature/humidity cycle test	12
5.6.1 Purpose.....	12
5.6.2 Storage conditions	12
5.6.3 Test cycle.....	13
5.7 Low air pressure test.....	16
5.7.1 Purpose.....	16
5.7.2 Storage conditions	17
5.8 Reporting.....	17
6 Measuring methods of light exposure properties.....	17
6.1 General remarks	17
6.1.1 Overview	17
6.1.2 Irradiance of the sunlight.....	17
6.1.3 Spectral irradiance of the sunlight	18
6.2 Conditioning.....	18
6.2.1 General	18
6.2.2 Temperature	19
6.2.3 Humidity	19
6.2.4 Surface contamination.....	19
6.2.5 Mounting of device(s).....	19

6.2.6	Test facility	19
6.2.7	Test apparatus.....	19
6.2.8	Laboratory light source.....	20
6.3	Procedures	22
6.3.1	General	22
6.3.2	Test patterns.....	22
6.3.3	Measurements	23
6.4	Light exposure testing	23
6.4.1	General	23
6.4.2	Procedure A – Direct sunlight.....	23
6.4.3	Procedure B – Daylight through window glass.....	23
6.4.4	Procedure C – Inner parts	24
6.5	Reporting.....	24
6.5.1	Information to be given in the relevant specification	24
6.5.2	Reporting.....	25
	Bibliography	26
	Figure 1 – Temperature profile	10
	Figure 2 – Temperature profile	11
	Figure 3 – Combination temperature/humidity cycle followed by exposure to cold.....	15
	Figure 4 – Combination temperature/humidity cycle not followed by exposure to cold.....	16
	Figure 5 – Global solar spectral irradiance at sea level	18
	Figure 6 – Examples of test pattern for black and white EPD and for colour EPD.....	23
	Table 1 – Standard conditions for reference measurements and tests	7
	Table 2 – Spectral irradiance (condensed from CIE 085-1989, Table 4)	18
	Table 3 – Relative spectral irradiance of xenon-arc lamps with daylight filters ^{a b}	21
	Table 4 – Relative spectral irradiance for xenon-arc lamps with window glass filters ^{ab}	22
	Table 5 – Exposure cycles	24

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRONIC PAPER DISPLAYS –**Part 4-2: Environmental test methods****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.

International Standard IEC 62679-4-2 has been prepared by IEC technical committee 110: Electronic display devices.

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

CDV	Report on voting
110/730/CDV	110/773A/RVC

Full information on the voting for the approval of this International Standard 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 62679 series, published under the general title *Electronic paper 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.

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

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.

ELECTRONIC PAPER DISPLAYS –

Part 4-2: Environmental test methods

1 Scope

This part of IEC 62679 specifies the environmental conditions to determine the environmental reliability of electronic paper display (EPD) panels and/or modules for storage under the assumed usage environment. The scope of this document is restricted to EPDs using either segment, passive, or active matrix with either monochromatic or colour type displays. The measuring methods are intended for EPDs operated in a reflective mode.

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 62679-1-1, *Electronic paper displays – Part 1-1: Terminology*

IEC 62679-3-1, *Electronic paper displays – Part 3-1: Optical measuring methods*

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

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

CIE 085-1989, *Solar spectral irradiance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62679-1-1, IEC 60068-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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

3.1 air mass

path length that light from a celestial object takes through the earth's atmosphere relative to the length at the zenith where air mass = 1

Note 1 to entry: The air mass is $1/\sin(\gamma)$, where γ is the elevation angle of the sun.

3.2

black standard temperature

temperature of an insulated stainless-steel plate, having a black coating