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**Ergonomics of human-system  
interaction — Electronic paper display  
— Indoor use**

*Ergonomie de l'interaction homme-système — Affichage de papier  
électronique — Utilisation à l'intérieure*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html)

The committee responsible for this document is ISO/TC 159, *Ergonomics*, Subcommittee SC4, *Ergonomics of human–system interaction*.

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## Introduction

The publication of the ISO 9241-300 series of International Standards addressed a wide range of visual display tasks and environments and provided the means for evaluating them. Not covered by those standards was the more recently developed electronic paper display (EPD) technology.

Owing to its unique optical characteristics, the current existing measuring methods may not be suitable for evaluating EPD.

Until measuring methods and compliance routes for EPD can be developed in the ISO 9241-300 series, this Technical Specification provides intermediate instruction and guidance. Using this Technical Specification together with ISO 9241-303 and ISO 9241-305 gives a good understanding of how to analyse an environment for which a specific analysis and compliance method does not yet exist.

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# Ergonomics of human-system interaction — Electronic paper display — Indoor use

## 1 Scope

This Technical Specification establishes test methods for evaluating electronic paper display (EPD) when used in indoor tasks and environments. It is intended to be applied together with the measurement procedures of ISO 9241-305 and the generic requirements of ISO 9241-303 to define compliance routes suitable for EPD.

## 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.

ISO 9241-302, *Ergonomics of human-system interaction — Part 302: Terminology for electronic visual displays*

ISO 9241-303, *Ergonomics of human-system interaction — Part 303: Requirements for electronic visual displays*

ISO 9241-305, *Ergonomics of human-system interaction — Part 305: Optical laboratory test methods for electronic visual displays*

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## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9241-302 and the following apply.

### 3.1

#### **electronic paper display**

#### **EPD**

electronic display that shows information by diffuse reflection and holds the image with low power consumption

### 3.2

#### **electronic reader**

#### **e-reader**

electronic device which shows information using EPD

## 4 Electronic paper display for indoor use — Display laboratory method

### 4.1 Intended context of use

The attributes of the user, environment, tasks and the use of electronic readers based on electronic paper display (EPD) are summarized in [Table 1](#). Attributes are derived from analysis of the intended context of use and are an essential prerequisite for the compliance assessment. Therefore, context elements different from those described in this method could influence the Pass/Fail criteria.

The supplier shall specify the intended context of use as well as the value or value range of an attribute. The values specified shall match the intended context of use. The intended context of use is part of the compliance report.

NOTE 1 Electronic readers with a diagonal of the active display area of up to approximately 7,1 inches (180 mm), corresponding to ISO A6 paper size, and up to 20,2 inches (514 mm), corresponding to ISO A3 paper size, are considered in this compliance route for typical visual display tasks for indoor use in work environments.

NOTE 2 Automotive environments, such as those of cars, trains and other vehicles, are not addressed here.

**Table 1 — Intended context of use**

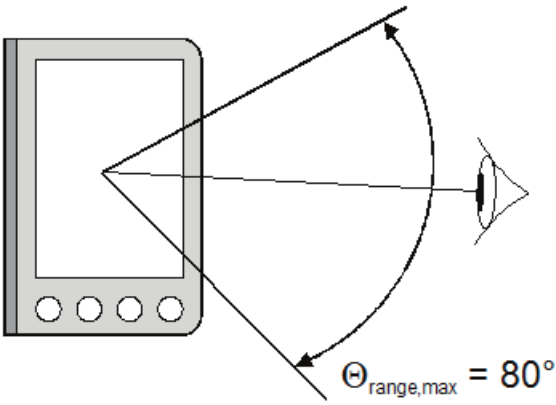
| Element     | Attribute  | Quantification   |
|-------------|--|--|
| User        | Age and vision   | User with normal or to normal corrected vision of any age, 7 years or older (any literate user).   |
| Environment | Design screen illuminance, $E_s$   | At indoor locations:<br>— minimum 20 lx<br>— maximum 1 500 lx<br><br>The supplier shall specify the design screen illuminance (or its range).  |
|             | Typical components of the illumination: large aperture source (15°) and small aperture source (1°) illumination. | N/A.<br><br>There is no evaluation of unwanted reflections.  |
|             | Illuminant   | For this compliance route CIE illuminant A, D50, D65, F11 and F12 are considered [5]. The supplier may specify the intended illuminant.<br><br>All these illuminants exist at every illuminance level of indoors use. Often in combinations. It is assumed that by verifying that the visual display complies in each of the illuminants, the visual display will also comply with any combination of illuminants.<br><br>The compliance assessment need only be performed once, with a spectrally broad-band laboratory illumination. The compliance calculations are then made using spectral calculations and repeated for each of the specified illumination levels and illuminants. |
|             | Ambient temperature  | For this compliance route an ambient temperature of approximate 15°C to 35°C is considered, if not otherwise specified by the supplier.  |



Table 1 (continued)

| Element | Attribute   | Quantification  |
|---------|---|---|
| Task    | Content and perception                            | <p>For this compliance route the following contexts for perception of information are considered, if not otherwise specified by the supplier.</p> <p><b>Artificial information</b></p> <p>Visualization of objects and scenes that do not have originals in our world, e.g. text (i.e. alphanumeric characters), graphical signs, symbols, etc. in monochrome (including achromatic) and/or multicolour (including full-colour) presentation.</p> <p>The Pass/Fail criteria may contain three different requirement levels, “High”, “Medium” and “Low”, which determine the degree to which a criterion is fulfilled:</p> <p>“<b>High</b>” for visual display tasks require high performance in e.g. colour gamut, grey scale but also higher comfort regarding character attributes;</p> <p>“<b>Medium</b>” for general visual display tasks require sufficient performance to perceive colour and to read the information without discomfort by the user;</p> <p>“<b>Low</b>” for visual display tasks require low performance in e.g. colour gamut and grey scale, but with sufficient performance to read the information without discomfort by the user.</p> |
|         | Amount of information                             | Preferred screen size for sufficient amount of information with appropriate object size and resolution.   |
|         | Image type  | For this compliance route the visual display shall be capable of displaying still and quasi-static images.  |
|         | Design viewing distance, $D_{\text{design,view}}$ | <p>The minimum design viewing distance, <math>D_{\text{design,view,min}}</math>, is <math>&gt; 200</math> mm.</p> <p>The supplier shall specify <math>D_{\text{design,view}}</math>.</p>  |
|         | Design viewing direction, $\theta_D, \Phi_D$      | Within a specific range of angles from the normal. For this compliance route, perpendicular viewing direction is assumed, if not otherwise specified by the supplier. Therefore, the default design viewing direction, $(\theta_D, \Phi_D)$ , is $(0^\circ, -)$ .   |

Table 1 (continued)

| Element | Attribute   | Quantification  |
|---------|---|---|
| Task    | Design viewing direction range (angle of inclination and azimuth) | <p>For this compliance route, a design viewing direction range of up to 80° is considered, if not otherwise specified by the supplier (as shown below).</p>  <p>Therefore, the maximum angle of inclination, <math>\theta</math>, is 40°. The azimuth angle, <math>\phi</math>, is 0° to 360°</p> |
|         | Eye and head position   | From fixed to moving.   |
|         | Number of users   | Typically single.   |
| Usage   | Display handling  | For this compliance route, stationary and portable display handling is considered, unless otherwise specified by the supplier.  |

4.2 Information about the technology

The basic physical attributes of electronic readers are given in Table 2.

The supplier shall submit a detailed technical specification which includes

- rated voltage,
- rated frequency,
- rated current,
- rated power consumption,
- panel specification,
- horizontal/vertical pixel size,
- original resolution,
- sub-pixel drawing,
- anti-reflection treatment,
- pixel fault declaration,
- prepared gamma-value, and
- factory setting of *brightness, contrast, colour* control.

The supplier shall also submit the test pattern, if required.

**Table 2 — Basic physical attributes of the visual display**

| Basic physical attribute            | Description   |
|-------------------------------------|---|
| Optical mode of operation           | Reflective  |
| Mode of observation                 | Direct-view   |
| Diagonal of the active display area | Approximately 7,1 inches (180 mm), corresponding to ISO-A6, and up to 20,2 inches (514 mm), corresponding to ISO-A3 paper sizes.  |
| Aspect ratio                        | Depending on application  |
| Resolution (addressable pixels)     | Depending on application  |
| Internal light source               | None or built-in light source.<br>If an electronic reader has supplement illumination, such as an integrated lighting unit on an EPD, either remove it or turn it off during testing. |
| Touch screen                        | None or built-in  |

### 4.3 Compliance assessment

The compliance assessment shall be given according to [Tables 3](#) to [13](#).

Electronic paper displays for electronic readers are used in a wide variety of illumination conditions. The darkroom or laboratory illumination condition can vary greatly from actual usage conditions. The approach of this compliance route is to perform the measurements under stable laboratory conditions with darkroom and laboratory light source illumination and then convert by calculation to the contexts of use prescribed by the compliance route.

Unless otherwise explicitly defined, a requirement is met only if it is met for all illuminance levels and illuminants defined in the intended context of use.

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**Table 3 — Viewing conditions**

| Attribute                       | Pass/Fail criteria based on requirements and intended context of use   | Measuring method                                | Assessment and reporting   |
|---------------------------------|--|---|--|
| <b>Design viewing distance</b>  | The design viewing distance is<br>a) for children, a minimum of 200 mm;<br>b) for adults, a minimum of 300 mm;<br>c) for elderly people, a minimum of 450 mm.<br>These requirements need to be considered in conjunction with the character height requirements. | Supplier specification, intended context of use | Use supplier-specified values or values obtained from intended context of use. Report the resulting value. |
| <b>Design viewing direction</b> | The visual display shall conform to all optical requirements over a relevant range of viewing directions. The design viewing direction ( $\theta_D$ , $\phi_D$ ), as well as the design viewing direction range shall be specified.                              | Supplier specification, intended context of use | Use supplier-specified values or values obtained from intended context of use. Report the resulting value. |