

**Ergonomics of human-system interaction - Part 303:  
Requirements for electronic visual displays (ISO 9241-  
303:2011)**

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

|                                                                                                                     |                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| See Eesti standard EVS-EN ISO 9241-303:2011 sisaldab Euroopa standardi EN ISO 9241-303:2011 ingliskeelset teksti.   | This Estonian standard EVS-EN ISO 9241-303:2011 consists of the English text of the European standard EN ISO 9241-303:2011.        |
| Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.                                                  | This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation. |
| Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 15.11.2011. | Date of Availability of the European standard is 15.11.2011.                                                                       |
| Standard on kättesaadav Eesti Standardikeskusest.                                                                   | The standard is available from the Estonian Centre for Standardisation.                                                            |

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile [standardiosakond@evs.ee](mailto:standardiosakond@evs.ee).

ICS 13.180, 35.180

### Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:  
Aru 10, 10317 Tallinn, Eesti; [www.evs.ee](http://www.evs.ee); telefon 605 5050; e-post [info@evs.ee](mailto:info@evs.ee)

### The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:  
Aru 10, 10317 Tallinn, Estonia; [www.evs.ee](http://www.evs.ee); phone 605 5050; e-mail [info@evs.ee](mailto:info@evs.ee)

English Version

**Ergonomics of human-system interaction - Part 303:  
Requirements for electronic visual displays (ISO 9241-303:2011)**

Ergonomie de l'interaction homme-système - Partie 303:  
Exigences relatives aux écrans de visualisation  
électroniques (ISO 9241-303:2011)

Ergonomie der Mensch-System-Interaktion - Teil 303:  
Anforderungen an elektronische optische Anzeigen (ISO  
9241-303:2011)

This European Standard was approved by CEN on 10 November 2011.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**Management Centre: Avenue Marnix 17, B-1000 Brussels**

## Foreword

This document (EN ISO 9241-303:2011) has been prepared by Technical Committee ISO/TC 159 "Ergonomics" in collaboration with Technical Committee CEN/TC 122 "Ergonomics" the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2012, and conflicting national standards shall be withdrawn at the latest by May 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 9241-303:2008.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

### Endorsement notice

The text of ISO 9241-303:2011 has been approved by CEN as a EN ISO 9241-303:2011 without any modification.

# Contents

Page

|                                                    |      |
|----------------------------------------------------|------|
| Foreword .....                                     | v    |
| Introduction.....                                  | viii |
| 1 Scope .....                                      | 1    |
| 2 Normative references .....                       | 1    |
| 3 Terms and definitions .....                      | 1    |
| 4 Guiding principles .....                         | 1    |
| 5 Ergonomic requirements and recommendations ..... | 2    |
| 5.1 Viewing conditions .....                       | 2    |
| 5.1.1 General .....                                | 2    |
| 5.1.2 Design viewing distance .....                | 2    |
| 5.1.3 Design viewing direction .....               | 3    |
| 5.1.4 Gaze and head tilt angles .....              | 4    |
| 5.1.5 Displays for virtual images .....            | 4    |
| 5.2 Luminance .....                                | 4    |
| 5.2.1 General .....                                | 4    |
| 5.2.2 Illuminance .....                            | 4    |
| 5.2.3 Display luminance .....                      | 4    |
| 5.2.4 Luminance balance and glare .....            | 5    |
| 5.2.5 Luminance adjustment .....                   | 5    |
| 5.3 Special physical environments .....            | 5    |
| 5.3.1 General .....                                | 5    |
| 5.3.2 Vibration .....                              | 5    |
| 5.3.3 Wind and rain .....                          | 6    |
| 5.3.4 Excessive temperatures .....                 | 6    |
| 5.4 Visual artefacts .....                         | 6    |
| 5.4.1 General .....                                | 6    |
| 5.4.2 Luminance non-uniformity .....               | 6    |
| 5.4.3 Colour non-uniformity .....                  | 6    |
| 5.4.4 Contrast uniformity .....                    | 7    |
| 5.4.5 Geometric distortions .....                  | 8    |
| 5.4.6 Screen and faceplate defects .....           | 8    |
| 5.4.7 Temporal instability (flicker) .....         | 8    |
| 5.4.8 Spatial instability (jitter) .....           | 9    |
| 5.4.9 Moiré effects .....                          | 9    |
| 5.4.10 Other instabilities .....                   | 10   |
| 5.4.11 Unwanted reflections .....                  | 10   |
| 5.4.12 Unintended depths effects .....             | 10   |
| 5.5 Legibility and readability .....               | 11   |
| 5.5.1 General .....                                | 11   |
| 5.5.2 Luminance contrast .....                     | 11   |
| 5.5.3 Image polarity .....                         | 11   |
| 5.5.4 Character height .....                       | 11   |
| 5.5.5 Text size constancy .....                    | 12   |
| 5.5.6 Character stroke width .....                 | 13   |
| 5.5.7 Character width-to-height ratio .....        | 13   |
| 5.5.8 Character format .....                       | 13   |
| 5.5.9 Between-character spacing .....              | 13   |
| 5.5.10 Between-word spacing .....                  | 13   |
| 5.5.11 Between-line spacing .....                  | 13   |

|                     |                                                                                                                |           |
|---------------------|----------------------------------------------------------------------------------------------------------------|-----------|
| <b>5.6</b>          | <b>Legibility of information coding</b> .....                                                                  | <b>14</b> |
| <b>5.6.1</b>        | <b>General</b> .....                                                                                           | <b>14</b> |
| <b>5.6.2</b>        | <b>Luminance coding</b> .....                                                                                  | <b>14</b> |
| <b>5.6.3</b>        | <b>Blink coding</b> .....                                                                                      | <b>14</b> |
| <b>5.6.4</b>        | <b>Colour coding</b> .....                                                                                     | <b>14</b> |
| <b>5.6.5</b>        | <b>Geometrical coding</b> .....                                                                                | <b>14</b> |
| <b>5.7</b>          | <b>Legibility of graphics</b> .....                                                                            | <b>14</b> |
| <b>5.7.1</b>        | <b>General</b> .....                                                                                           | <b>14</b> |
| <b>5.7.2</b>        | <b>Monochrome and multicolour object size</b> .....                                                            | <b>14</b> |
| <b>5.7.3</b>        | <b>Contrast for object legibility</b> .....                                                                    | <b>15</b> |
| <b>5.7.4</b>        | <b>Colour considerations for graphics</b> .....                                                                | <b>15</b> |
| <b>5.7.5</b>        | <b>Background and surrounding image effects</b> .....                                                          | <b>16</b> |
| <b>5.7.6</b>        | <b>Number of colours</b> .....                                                                                 | <b>16</b> |
| <b>5.8</b>          | <b>Fidelity</b> .....                                                                                          | <b>17</b> |
| <b>5.8.1</b>        | <b>General</b> .....                                                                                           | <b>17</b> |
| <b>5.8.2</b>        | <b>Colour gamut and reference white</b> .....                                                                  | <b>17</b> |
| <b>5.8.3</b>        | <b>Gamma and grey scale</b> .....                                                                              | <b>17</b> |
| <b>5.8.4</b>        | <b>Rendering of moving images</b> .....                                                                        | <b>18</b> |
| <b>5.8.5</b>        | <b>Image formation time (IFT)</b> .....                                                                        | <b>19</b> |
| <b>5.8.6</b>        | <b>Spatial resolution</b> .....                                                                                | <b>19</b> |
| <b>5.8.7</b>        | <b>Raster modulation or fill factor</b> .....                                                                  | <b>19</b> |
| <b>5.8.8</b>        | <b>Pixel density</b> .....                                                                                     | <b>20</b> |
| <b>6</b>            | <b>Conformance</b> .....                                                                                       | <b>20</b> |
| <b>Annex A</b>      | <b>(informative) Overview of the ISO 9241 series</b> .....                                                     | <b>21</b> |
| <b>Annex B</b>      | <b>(informative) Attractivity, or subject visual quality</b> .....                                             | <b>22</b> |
| <b>Annex C</b>      | <b>(informative) Usability aspects of installation</b> .....                                                   | <b>23</b> |
| <b>Annex D</b>      | <b>(normative) Basic concepts of visual perception for contrast and luminance of electronic displays</b> ..... | <b>25</b> |
| <b>Annex E</b>      | <b>(informative) Virtual display — Performance objectives</b> .....                                            | <b>33</b> |
| <b>Annex F</b>      | <b>(informative) Electronic visual display accessibility — Selected bibliography</b> .....                     | <b>40</b> |
| <b>Bibliography</b> | .....                                                                                                          | <b>42</b> |

## Introduction

This part of ISO 9241 addresses a large range of technologies, tasks and environments.

ISO 9241 was originally developed as a seventeen-part International Standard on the ergonomics requirements for office work with visual display terminals. As part of the standards review process, a major restructuring of ISO 9241 was agreed to broaden its scope, to incorporate other relevant standards and to make it more usable. The general title of the revised ISO 9241, “Ergonomics of human-system interaction”, reflects these changes and aligns the standard with the overall title and scope of Technical Committee ISO/TC 159, Subcommittee SC 4. The revised multipart standard is structured as series of standards numbered in the “hundreds”: the 100 series deals with software interfaces, the 200 series with human-centred design, the 300 series with visual displays, the 400 series with physical input devices, and so on.

See Annex A for an overview of the entire ISO 9241 series.

# Ergonomics of human-system interaction —

## Part 303:

## Requirements for electronic visual displays

### 1 Scope

This part of ISO 9241 establishes image-quality requirements, as well as providing guidelines, for electronic visual displays. These are given in the form of generic — independent of technology, task and environment — performance specifications and recommendations that will ensure effective and comfortable viewing conditions for users with normal or adjusted-to-normal eyesight.

This part of ISO 9241 does not address issues of accessibility for people with disabilities. However, it does take into account aspects of the eyesight of older people and could be of value to people dealing with issues of visual impairment in certain cases: the specification of essential characteristics for normal viewing can be used to gauge the severity of different visual abnormalities so that appropriate solutions can be identified.

**NOTE** In addition to the Bibliography, Annex F gives a selected bibliography of documents addressing the needs of people with disabilities, including people with poor, deteriorating or no eyesight.

### 2 Normative references

The following referenced documents are indispensable for the application 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.

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

ISO 9241-307, *Ergonomics of human-system interaction — Part 307: Analysis and compliance test methods for electronic visual displays*

### 3 Terms and definitions

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

### 4 Guiding principles

For a satisfying human–display interaction, a number of different requirements have to be met at the same time in an appropriate balance. For the purposes of this part of ISO 9241, these requirements have been grouped into the following eight major areas:

- viewing conditions;
- luminance;
- special physical environments;