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Ergonomics of human-system interaction —

Part 311: Application of ISO 9241-307: LCD screens for workstations

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Contents

Page

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).

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).

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For an explanation of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

This first edition cancels and replaces ISO 9241-3:1992.

A list of all parts in the ISO 9241 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The ISO 9241-30x family of standards has replaced ISO 9241-3[1)], ISO 9241-7[1)], ISO 9241-8[1)], ISO 13406-1[1)] and ISO 13406-2[1)]. The overall goal of the restructuring was to design a modular standard enabling an easy way of adding new intended contexts of use, new measurement methods or new technologies in the ISO 9241-30x family of standards.

The ISO 9241-30x family of standards consists of seven individual standards. Table 1 gives an overview (for details see the standards themselves).

This document refers to ISO 9241-307. It helps explain the transition from the earlier structure of the related standards to the current structure. It will be revised or withdrawn following the revision of ISO 9241-307.

Table 1 — Overview of the ISO 9241-30x family of standards

Part of ISO 9241-30x	Title and explanation
ISO 9241-300	Introduction to electronic visual display requirements — This part introduces the ISO 9241-30x family of standards and explains the modular structure.
ISO 9241-302	Terminology for electronic visual displays — This part explains the terms and definitions used in the series.
ISO 9241-303	Requirements for electronic visual displays — This part establishes fundamental image-quality requirements on a generic basis. For assessing its requirements, a testing method is needed regarding its technology, task and environment.
ISO 9241-304	User performance test methods for electronic visual displays — This part provides guidance for assessing the visual ergonomics of display technologies with user performance test methods.
ISO 9241-305	Optical laboratory test methods for electronic visual displays — This part contains test methods for measurement of the requirements given in ISO 9241-303.
ISO 9241-306	Field assessment methods for electronic visual displays — This part describes simplified optical, geometrical and visual assessment methods that can be used for on-site measurements at visual display workstations.[a]
ISO 9241-307	Analysis and compliance test methods for electronic visual displays — This part establishes test methods for the analysis of a variety of visual display technologies, tasks and environments. It refers to the general requirements given in ISO 9241-303 and test methods given in ISO 9241-305 for assessment of conformity for different (display-) technologies and the anticipated contexts of use.
[a] ISO test charts for the visual assessment of the display output by yes/no question are available from: https://standards.iso.org/iso/9241/306/ed-2/index.html https://standards.iso.org/iso/9241/306/ed-2/AE09/AE09F0PX.PDF (achromatic, 2 MB) https://standards.iso.org/iso/9241/306/ed-2/AE18/AE18F0PX.PDF (chromatic, 14 MB)	

1) Cancelled and replaced by ISO 9241-302, ISO 9241-303, ISO 9241-304, ISO 9241-305, ISO 9241-307 and ISO 9241-311.

Ergonomics of human-system interaction —

Part 311:
Application of ISO 9241-307: LCD screens for workstations

1 Scope

This document provides information relating to the specification of liquid crystal display (LCD) screens at visual display workstations in indoor locations, in accordance with ISO 9241-307:2008, 5.2. The information is limited to LCD screens, since these are typically used at workstations.

The information is intended to support managerial decision makers (e.g. procurement operators, companies' safety committees, occupational safety and health professionals) who are responsible for the acquisition of visual displays.

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.

ISO 9241-302:2008, *Ergonomics of human-system interaction — Part 302: Terminology for electronic visual displays*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
artificial information
visualization of objects and scenes that do not have originals in our world in monochrome (including achromatic) and/or multicolour (including full-colour) presentation

EXAMPLE Text (i.e. alphanumeric characters), graphical signs, symbols.

Note 1 to entry: See ISO 9241-307:2008, Table 38.

3.2
reality information
imaging of objects and scenes that do have existing originals in our world in monochrome (including achromatic) and/or multicolour (including full-colour) presentation

EXAMPLE Faces, people, landscapes.

Note 1 to entry: See ISO 9241-307:2008, Table 38.

3.3
design viewing direction
specific direction from which the visual display is intended to be viewed

Note 1 to entry: See ISO 9241-307:2008, Table 38.

Note 2 to entry: Reality information is not considered.

3.4
design screen illuminance
specific maximum illuminance on the screen caused by ambient illumination

Note 1 to entry: See ISO 9241-307:2008, Table 38.

3.5
luminance balance
ratio between the luminances of the displayed image and its adjacent surround or sequentially viewed surfaces

[SOURCE: ISO 9241-302:2008, 3.4.18]

3.6
colour non-uniformity
change of a colour in the active area of the screen

Note 1 to entry: See ISO 9241-303:2011, 5.4.3.

Note 2 to entry: Variation considers lateral and directional changes.

3.7
contrast non-uniformity
unintended variations in contrast (luminance ratio) in the active area of the screen

Note 1 to entry: There are three different forms of contrast non-uniformity:

— variation in area average luminance contrast from the centre of a display to the edge of any portion thereof;

— variation of the peak contrast of character elements (dots or strokes) at different locations of the screen;

— variation of the peak contrast of character elements (dots or strokes) within a character.

Note 2 to entry: See ISO 9241-303:2011, 5.4.4.

3.8
visual artefacts
Moiré effects
regular image superimposed on the intended image

Note 1 to entry: Moiré effects can appear as ripples, waves and intensity variations.

Note 2 to entry: Moiré effects are disturbing information.

Note 3 to entry: See ISO 9241-303:2011, 5.4.9.

3.9
unintended depth effects
perception of depth by combination of spectrally extreme colours

EXAMPLE Combination of red and blue.

Note 1 to entry: See ISO 9241-303:2011, 5.4.12.

3.10
luminance contrast
ratio between the higher luminance, L_H, and lower luminance, L_L, that defines the feature to be detected

Note 1 to entry: ISO 9241-303:2011, ISO 9241-305:2008 and ISO 9241-307:2008 use luminance contrast measured by contrast modulation or measured by contrast ratio.

[SOURCE: ISO 9241-302:2008, 3.1.7, modified — Notes to entry replaced.]

3.11
image polarity
relationship between background brightness and image brightness

Note 1 to entry: The presentation of brighter characters on a darker background is designated as *negative* polarity, and the presentation of darker characters on a brighter background is designated as *positive* polarity.

[SOURCE: ISO 9241-302:2008, 3.4.15]

3.12
character format
number of horizontal and vertical elements of a character

Note 1 to entry: An element is understood to be a pixel, which is the smallest element that is capable of generating the full intended functionality (e.g. colour and grey scale) of the display.

[SOURCE: ISO 9241-302:2008, 3.6.5, modified — definition revised and notes to entry replaced.]

3.13
luminance coding
information presented by temporally independent differences in image luminances

EXAMPLE Information highlighted by differences in luminance.

Note 1 to entry: Absolute luminance coding is understood to be information presented where the only dimension that is used for visual differentiation is the difference in image luminances (see ISO 9241-302:2008, 3.4.1).

[SOURCE: ISO 9241-302:2008, 3.4.19, modified — example and Note 1 to entry added.]

3.14
blink coding
information presented by temporal luminance variations in images

[SOURCE: ISO 9241-302:2008, 3.3.8]

3.15
colour coding
information coding by using distinguishable colours

Note 1 to entry: See ISO 9241-303:2011, 5.6.4.

3.16
geometrical coding
information coding by using different geometrical shapes

EXAMPLE Use of graphical symbols (e.g. triangles and circles for distinguishing curves in diagrams).

Note 1 to entry: See ISO 9241-303:2011, 5.6.5.

3.17
object size
visual angle required for objects to be recognizable

Note 1 to entry: See ISO 9241-303:2011, 5.7.2.

Note 2 to entry: Object size can be monochrome or multicolour.

3.18
contrast for object legibility
contrast required for objects to be recognizable

Note 1 to entry: See ISO 9241-303:2011, 5.7.3.

3.19
colour considerations for graphics
summary of requirements for coloured symbols or characters

Note 1 to entry: A default colour set with distinguishable colours is required to be available. Characters and symbols need to be presented with a visual angle of at least 20′ of arc at the design viewing distance (2,9 mm height of character or symbol at 500 mm viewing distance). Where accurate colour identification of an isolated image such as a character or symbol is required, the image should be at least 30′ of arc at the design viewing distance, preferably 45′ of arc.

Note 2 to entry: See ISO 9241-303:2011, 5.7.4.

3.20
surrounding image effects
background
effects with reference to the discriminability of image background and image foreground

Note 1 to entry: For colours to be discriminable and identifiable, coloured foreground images should be used on achromatic background and vice versa.

Note 2 to entry: See ISO 9241-303:2011, 5.7.5.

3.21
colour gamut
number of colours used by an application as a percentage of all colours of the chromaticity diagram

Note 1 to entry: Depending on the application for office tasks (artificial information), a minimum of six and a maximum of 11 discriminable colours should be provided.

Note 2 to entry: See ISO 9241-303:2011, 5.7.6 and 5.8.2.1 and ISO 9241-307:2008, Table 83.

3.22
reference white
specified reference for the white achromatic stimulus displayed on the monitor

Note 1 to entry: See ISO 9241-307:2008, Table 83.

3.23
electro-optical transfer function
function describing the relationship between input signal of a display and the displayed luminance

Note 1 to entry: See ISO 9241-307:2008, Table 86.

3.24
grey scale
greys displayed by more than two luminance levels

Note 1 to entry: See ISO 9241-307:2008, Table 86.

3.25
image formation time
time that is needed by the display to change the image from one luminance state to another luminance state and vice versa

[SOURCE: ISO 9241-302:2008, 3.4.14, modified — definition revised; example and note to entry deleted.]

3.26
spatial resolution
display resolution in horizontal pixels times vertical pixels

Note 1 to entry: See ISO 9241-303:2011, 5.8.6.

3.27
fill factor
fraction of the total pixel area geometrically available that can be altered to display information

Note 1 to entry: For discrete-pixel displays, the outer boundary of all the pixels defines the active area. Between the pixels and subpixels are gaps that structurally support or define the pixel. The ratio of the active area minus the area of the gaps to the active area is the fill factor.

[SOURCE: ISO 9241-302:2008, 3.4.10]

3.28
pixel density
number of pixels per dimension

EXAMPLE ppi = pixels per inch.

Note 1 to entry: The dimension can be a length measured in centimetres or inches, or an angle measured in degrees at the design viewing distance.

Note 2 to entry: See ISO 9241-303:2011, 5.8.7, 5.8.8 and ISO 9241-307:2008, Table 91.

4 Classification, profiles and screen selection

4.1 General

In combination with ISO 9241-303 and ISO 9241-305, ISO 9241-307 forms the basis for conformity assessment of LCD screens and is therefore considered to be the relevant standard for the acquisition and specification of screens.

Whereas ISO 9241-3, ISO 9241-7, ISO 9241-8, ISO 13406-1 and ISO 13406-2 mainly took visual display workstations into account, the scope of ISO 9241-307 was broadened and additional technologies were considered.

The broad scope of ISO 9241-307 includes the following changes:

— consideration of illuminance between 50 lx and 1 500 lx;

— consideration of the luminance of an extended light source that can reflect in the screen, with higher values of 300 cd/m^2 or 500 cd/m^2;

— integration of CIE-illuminants A, F11 and F12[2)];

— discrimination between “artificial information” and “reality information” regarding content and perception.

ISO 9241-307 considers the following technologies:

— Cathode ray tube (CRT) displays;

— emissive flat-panel LCD;

— plasma display panels;

— front-screen projection visual displays;

2) CIE standard illuminant A (ISO 11664-2:2007/CIE S 014-2:2006), CIE illuminants FL11 and FL12 (CIE 018:2018)

— emissive, reflective and transflective LCDs for hand-held devices.

Extending the scope led to discontinuation of the former classification (e.g. of the hitherto known reflection classes according to ISO 13406-2. In ISO 9241-307 this is replaced by the corresponding luminances. Comparability with the former reflection classes is guaranteed. Table 2 shows the correlation of the former reflection classes to the luminances.

Table 2 — Comparison of reflection classes

Reflection class according to ISO 13406-2	Luminance of directional reflected light sources [cd/m²] according to ISO 9241-307	Example for environment ISO 9241-307 (ISO 13406-2, ISO 9241-7)
N/A	$L_{REF,\ EXT}$ = 500 and $L_{REF,\ SML}$ = N/A[a]	For specialized use with very stringent level on robustness against light[b]
N/A	$L_{REF,\ EXT}$ = 300 and $L_{REF,\ SML}$ = N/A[c]	For general use in offices near windows with stringent level on robustness against light[d]
I	$L_{REF,\ EXT}$ = 200 and $L_{REF,\ SML}$ = 2 000	General office use[e]
II	$L_{REF,\ EXT}$ = 200 or $L_{REF,\ SML}$ = 2 000	For most but not all office environments[f]
III	$L_{REF,\ EXT}$ = 200 or $L_{REF,\ SML}$ = 125	Requires a specially controlled luminous environment[g]

Key

N/A not applicable

REF, EXT large reference aperture source

REF, SML small reference aperture source

[a] $L_{REF,\ SML}$ = 5 000 cd/m².

[b] Workstations with a very high illumination level.

[c] $L_{REF,\ SML}$ = 3 000 cd/m².

[d] Workstations near windows, sun protection used only slightly.

[e] Visual displays of this type can be used in any office environment. Workstations near windows, sun protection used in good time.

[f] Visual displays of this type can cause disturbing reflections if used in environments with no ideal lighting or positioned near windows. Workstations far from windows with low illumination level.

[g] Visual displays of this type cause greatly disturbing reflections, so these devices cannot be used for office work under normal office environments. These disturbances can only be handled by complete diffuse lighting, which, however, is hardly realizable from a technical point of view. Furthermore, the reflection of bright surfaces in the screens (e.g. walls, windows) needs to be avoided. Workstations far from windows with completely diffuse lighting and without bright surfaces (e.g. walls, windows) that can be reflected in the screen.

Additional changes or innovations in classification have been made in, for example, colour non-uniformity and pixel fault classification. For “reality information”, higher levels of image quality are defined.

In detail, Table 3 shows changes within the classification of the colour non-uniformity.

Table 3 — Comparison of the classification of colour non-uniformity

Class according to ISO 13406-2	Classification according to ISO 9241-307	The classification is fulfilled…
III	High class chromaticity uniformity in a viewing cone with a single visual display	… for all colour combinations[a] R and/or G and/or B = 100 % R and G and B = 75 % R and/or G and/or B = 50 %
III	Medium class chromaticity uniformity in a viewing cone with a single visual display	… for all colour combinations [a] R and/or G and/or B = 100 % R = G = B = 75 %
III	Low class chromaticity uniformity in a viewing cone with a single visual display	… only for primary colours R = 100 %, G = 100 %, B = 100 %
IV	Low class chromaticity uniformity in a restricted viewing cone	… for all colours in a restricted viewing cone
[a] Pigment content of red, green and blue for generating mixed colours or primary colour.		

The pixel fault classes have been changed as shown in Table 4 and Table 5, which give a (simplified) comparison between the possible pixel fault classes of ISO 9241-307 and the former classifications according to ISO 13406-2 for all typical screen sizes found at workstations.

Table 4 — Comparison of pixel fault classes

Classification according to ISO 13406-2	ISO 9241-307 pixel fault class $Class_{Pixel}$	Type 1 (Pixel permanently bright)	Type 2 (Pixel permanently dark)	Type 3 (Subpixel permanently bright/dark)
I	0	0	0	0/0
—	I	1	1	2/1
II	II	2	2	5/0
III	III	5	15	50/0
IV	IV	50	150	500/0
NOTE 1 Numerical data: maximum number of faults per type and per million pixels.				
NOTE 2 ISO 13406-2 had not differentiated between “permanently bright”/”permanently dark” subpixel faults. This is new with ISO 9241-307.				

Table 5 — Comparison of the pixel fault classes – Continuation

ISO 9241-307 $Class_{Pixel}$	Type 1 (Pixel permanently bright)	Type 2 (Pixel permanently dark)	Type 3		Accumulation of Type 1 or Type 2	Accumulation of Type 3
			Permanently bright	Permanently dark		
0	0	0	0	0	0	0
I	1	1	2	1	0	0
	1	1	1	3	0	0
	1	1	0	5	0	0
NOTE 1 Numerical data: maximum number of faults per type and per million pixels.						
NOTE 2 The classification is made by declaring the pixel fault class and the counter n_x. In pixel fault class II the counter is n_{II} = 1, 2, 3 or 4.						
NOTE 3 Bright pixel faults are perceived more intensely than dark pixel faults.						

Table 5 *(continued)*

ISO 9241-307 $Class_{Pixel}$	Type 1 (Pixel permanently bright)	Type 2 (Pixel permanently dark)	Type 3		Accumulation of Type 1 or Type 2	Accumulation of Type 3
			Permanently bright	Permanently dark		
II	2	2	5	0	0	1
	2	2	$5 - n_{II}$	$2 \times n_{II}$	0	1
	2	2	0	10	0	1

NOTE 1 Numerical data: maximum number of faults per type and per million pixels.

NOTE 2 The classification is made by declaring the pixel fault class and the counter n_x. In pixel fault class II the counter is n_{II} = 1, 2, 3 or 4.

NOTE 3 Bright pixel faults are perceived more intensely than dark pixel faults.

4.2 Profiles

4.2.1 General

This document provides information to support decision making on the specification of LCD screens at workstations. It only deals with LCD screens, since those are typically used at workstations.

Four different profiles are provided, which describe different environmental conditions, tasks and visual display attributes.

It is the task of a managerial decision maker to compare the intended use of a screen to the different profiles and to identify the profile needed. Once the profile is identified, the associated attributes the visual display is to meet can be taken from the attributes table. Note that all statements made are informative. The binding document is ISO 9241-307.

In the following subclauses each of the profiles is defined. They differ in robustness against ambient light, task and image quality.

Each profile describes:

— the number of visual displays at the workstation;

— the observation conditions of the screen;

— the content of the displayed information, including examples;

— perception and identification of colours and luminances;

— environmental conditions at the workstation;

— perception of pixel faults and other visual image artefacts.

NOTE 1 The profiles are examples and cannot reflect each possible use case.

NOTE 2 For the acquisition of LCD screens at workstations, a profile is chosen that is most similar to the intended use.

NOTE 3 Profiles can be individualized according to the context of use. In an environment with low ambient illuminance, for example, a higher colour uniformity and/or higher colour gamut might be needed due to the need to view several displays from a workstation in a fixed position or due to the task at hand. Also, depending on the task, more stringent levels might be defined regarding the image formation time and/or the monotony of the electro-optical transfer function.

NOTE 4 In case of doubt a higher level is chosen for the individual attribute.

NOTE 5 The choice of a profile is the responsibility of the managerial decision maker.

NOTE 6 The profiles have been created under consideration of current applications. The profiles will be subject to change with advancing technologies and software or changing tasks.

4.2.2 Profile No. 1

a) The workstation is generally equipped with one single visual display.

b) The whole screen is viewed from a fixed position and from a viewing distance of at least 500 mm by a single user.

c) Purely artificial information is presented without moving images, for example as text processing with dark characters on a bright background (positive polarity) or bright characters on a dark background (negative polarity).

d) The perception and identification of colours is of minor importance.

e) The workstation is located in a controlled illuminated environment.

NOTE A controlled illuminated environment minimizes disturbing reflections on screens, enabling screens with poor antireflection treatment to be used.

f) Pixel faults do not appear.

g) Within the given limits, no other visual artefacts (i.e. information competing against the intended information for the user) appear.

4.2.3 Profile No. 2

a) The workstation is generally equipped with one single visual display.

b) The whole screen is viewed from a fixed position and from a viewing distance of at least 500 mm by a single user.

c) Predominantly artificial information is presented without moving images, for example as text processing, spreadsheet processing or applications for communication.

d) The perception and identification of colours is of medium importance.

e) The workstation is located in a general office environment.

f) Pixel faults do not appear.

g) Within the given limit, no other visual artefacts (i.e. information competing against the intended information for the user) appear.

4.2.4 Profile No. 3

a) The workstation is generally equipped with one single visual display; use of two visual displays is not excluded;

b) The whole screen is viewed from a fixed position and from a viewing distance of at least 500 mm by a single user. Viewing distances up to 750 mm and multiple users are not excluded;

c) Predominantly artificial information is presented without moving images. In addition to the listed applications, tasks include, for example, preparation of presentations with coloured graphics. Furthermore, company-specific software can be used;

d) The perception and identification of colours is of medium to high importance.

e) The workstation is typically placed in a general office environment. Higher illuminances of up to 1 500 lx can occur (e.g. at workstations near windows).

f) Pixel faults do not appear.

g) Within the given limit, no other visual artefacts (i.e. information competing against the intended information for the user) appear.

4.2.5 Profile No. 4

a) The workstation is typically equipped with two visual displays;

b) The whole screen is viewed from a fixed position and from a viewing distance of at least 500 mm by a single user. Viewing distances up to 750 mm and multiple users are not excluded.

c) Predominantly artificial information is presented without moving images. In addition to the listed applications, tasks include, for example, preparation of coloured graphics, use of reality information (without image processing), operating, monitoring and regulating of processes.

d) The perception and identification of colours is of high importance.

e) The workstation is typically placed in a general office environment. Higher illuminances of up to 1 500 lx can occur (e.g. at workstations near windows).

f) Pixel faults do not appear;.

g) Within the given limit, no other visual artefacts (i.e. information competing against the intended information for the user) appear.

4.3 Comparison of the profiles

Table 6 shows the attributes of ISO 9241-307 allocated to each profile for two different configurations (see Figure 1 and Figure 2).

NOTE Attributes specified as “not applicable” within ISO 9241-307 are not presented here.

The selection of a suitable visual display is carried out by comparison of the attributes according to the selected profile and the associated results given by the ISO 9241-307 test report of an accredited laboratory according to ISO/IEC 17025.

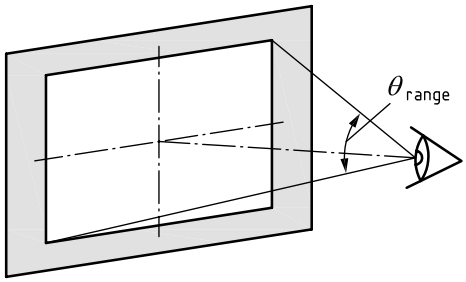
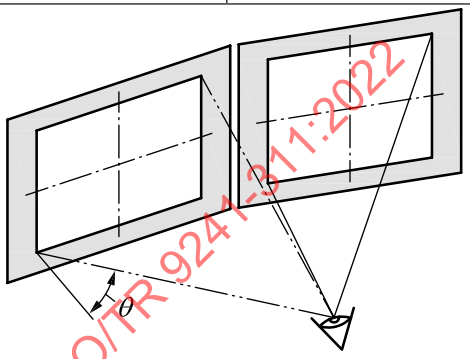
NOTE The ISO 9241-307 test report is intended to refer explicitly to the visual display to be considered.

In the case of an individualized profile, the individualized attributes apply.

If no deviations occur during the comparison, the selected visual display is suitable for the chosen profile. A visual display fulfilling even more than the level of that attribute is always suitable for the chosen profile.

If deviations occur such that the visual display does not fulfil the level of the attribute of the chosen profile or of the individualized profile, the visual display is not suitable for this profile.

Table 6 — Profiles and their attributes

Attribute	Profile No. 1	Profile No. 2	Profile No. 3	Profile No. 4
Design viewing distance	500 mm	500 mm	500 mm	500 mm
Design viewing direction	Viewing cone with a single visual display at the design viewing distance from a fixed viewing position by a single user	Viewing cone with a single visual display at the design viewing distance from a fixed viewing position by a single user	Viewing cone with one or two visual displays at the design viewing distance and moving head position by a single user	Viewing cone with one or two visual displays at the design viewing distance and moving head position by a single user
				
	Figure 1 — Viewing cone with one single visual display		**Figure 2 — Viewing cone with one or two visual displays and with head movement**	
Design screen illuminance	≤ 250 lx (no workstations near windows)	≤ 750 lx (no workstations near windows)	≤ 1 500 lx	≤ 1 500 lx
Display luminance	≥ 100 cd/m^2	≥ 150 cd/m^2	≥ 150 cd/m^2	≥ 150 cd/m^2
Luminance balance and glare	Gloss of the housing ≤ 20 gloss units measured in 60° measurement geometry	Gloss of the housing ≤ 20 gloss units measured in 60° measurement geometry	Gloss of the housing ≤ 20 gloss units measured in 60° measurement geometry	Gloss of the housing ≤ 20 gloss units measured in 60° measurement geometry
Luminance and contrast adjustment	a) The display luminance of the low and/or the high state is manually or automatically adjustable to the environmental lighting conditions.	a) The display luminance of the low and/or the high state is manually or automatically adjustable to the environmental lighting conditions.	a) The display luminance of the low and/or the high state is manually or automatically adjustable to the environmental lighting conditions.	a) The display luminance of the low and/or the high state is manually or automatically adjustable to the environmental lighting conditions.
	b) The display luminance of the low state should be adjustable.	b) The display luminance of the low state should be adjustable.	b) The display luminance of the low state should be adjustable.	b) The display luminance of the low state should be adjustable.
	c) The display luminance of the high state is adjustable.	c) The display luminance of the high state is adjustable.	c) The display luminance of the high state is adjustable.	c) The display luminance of the high state is adjustable.
	d) The luminance of the low and high state should be adjustable independently.	d) The luminance of the low and high state should be adjustable independently.	d) The luminance of the low and high state should be adjustable independently.	d) The luminance of the low and high state should be adjustable independently.
	e) Adjustment of the display luminance (luminance of the low and/or high state) should not affect the electro-optical transfer function (EOTF) or the gamma value.	e) Adjustment of the display luminance (luminance of the low and/or high state) should not affect the electro-optical transfer function (EOTF) or the gamma value.	e) Adjustment of the display luminance (luminance of the low and/or high state) should not affect the electro-optical transfer function (EOTF) or the gamma value.	e) Adjustment of the display luminance (luminance of the low and/or high state) should not affect the electro-optical transfer function (EOTF) or the gamma value.