BRITISH STANDARD

BS EN ISO
13406-1:1999

Ergonomic requirements for work with visual display based on flat panels —

Part 1: Introduction

The European Standard EN ISO 13406-1:1999 has the status of a British Standard

ICS 13.180; 35.180

National foreword

This British Standard is the English language version of EN ISO 13406-1:1999. It is identical with ISO 13406-1:1999.

The UK participation in its preparation was entrusted by Technical Committee PH/9, Ergonomics, to Subcommittee PH/9/6, User system interaction, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

Attention is drawn to the fact that CEN and CENELEC Standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement these international or European publications may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN ISO title page, page 2, the ISO title page, pages ii to iv, pages 1 to 4 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

This British Standard, having been prepared under the direction of the Health and Environment Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 December 1999

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EUROPEAN STANDARD

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EN ISO 13406-1

October 1999

ICS 13.180; 35.180

English version

Ergonomic requirements for work with visual display based on flat panels — Part 1: Introduction

(ISO 13406-1:1999)

Exigences ergonomiques pour travail sur écrans de visualisation à panneaux plats — Partie 1: Introduction
(ISO 13406-1:1999)

Ergonomische Anforderungen an optische Anzeigeeinheiten in Flachbauweise — Teil 1: Einführung
(ISO 13406-1:1999)

This European Standard was approved by CEN on 3 September 1999.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

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Foreword

The text of the International Standard ISO 13406-1:1999 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 April 2000, and conflicting national standards shall be withdrawn at the latest by April 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 13406-1:1999 was approved by CEN as a European Standard without any modification.

NOTE Normative references to International Standards are listed in Annex ZA (normative).

INTERNATIONAL STANDARD

ISO 13406-1

First edition
1999-10-01

Ergonomic requirements for work with visual displays based on flat panels —

Part 1:
Introduction

Exigences ergonomiques pour travail sur écrans de visualisation à panneaux plats —

Partie 1: Introduction

Reference number
ISO 13406-1:1999(E)

Contents

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 13406-1 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Sub-Committee SC 4, *Ergonomics of human-system interaction*, WG 2, *Visual display requirements*, in collaboration with IEC/SC 47C/WG 2 (responsible for flat-panel engineering standards).

ISO 13406 consists of the following parts, under the general title *Ergonomic requirements for work with visual displays based on flat panels:*

— *Part 1: Introduction;*

— *Part 2: Requirements for flat panel displays*.

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Introduction

ISO 13406 addresses the ergonomic considerations that should be taken into account when using flat-panel visual displays. ISO 13406 is based on the ergonomic foundations and principles addressed in ISO 9241. During the development of ISO 9241-3:1992, it was recognized that the use of the same ergonomic principles results in a different approach and specification for flat panels.

ISO 13406 exists for three reasons:

a) ISO 9241 is sometimes not sufficient to ensure that a display meets basic front-of-screen ergonomic requirements when flat-panel visual displays are used instead of conventional CRT-based VDTs;

b) ISO 9241 measurement methods are sometimes inappropriate for characterizing flat-panel visual displays;

c) ISO 9241 addresses office work, but the scope of ISO 13406 includes extended uses and applications.

Examples of special flat-panel considerations are

— picture element discreteness (leading to the possibility of isolated defects);

— optical properties that strongly depend on viewing direction (leading to the need to carefully describe viewing direction during evaluation);

— slow response time of the electro-optical effect (leading to suitability questions when image dynamics are important for performance or comfort);

— panels that electrically vary the reflection properties at the picture element site (leading to complications in evaluation).

ISO 13406, where appropriate, provides physical requirements based on models in ergonomic research and physical measurement protocols to provide consistent compliance decisions. In ISO 9241-3, ISO 9241-7 and ISO 9241-8, an alternative decision route is sometimes appropriate and necessary. These three standards include annexes concerning visual performance tests. These tests address legibility, legibility when unwanted reflections exist on the display screen, and discriminability of colours. When these tests are approved, they will provide an alternative means to decide compliance. These tests (unmodified or with appropriate modifications to account for flat-panel specific environmental considerations) may be used to decide compliance to ISO 13406-2.

ISO 13406-2 treats the ergonomics of directly viewed flat-panel displays. It covers the ergonomic topics of ISO 9241-3, ISO 9241-7, and ISO 9241-8. The requirements and measurements in ISO 13406-2 treat panels with uniformly spaced and constructed pixels. In addition, panels are sufficiently large to display at least three measurement targets, of at least 400 pixels each, that do not overlap.

Figure 1 illustrates a directly viewed flat-panel configuration that cannot be evaluated under ISO 13406-2 because each pixel is specially sized and shaped to represent a specific portion of a numeric symbol. This type of display is known as a segmented display.

Figure 2 illustrates another directly viewed flat-panel configuration that cannot be evaluated under ISO 13406-2 because the uniformly constructed pixels are not uniformly spaced. For economic reasons, the pixel positions between character rows and columns are omitted. With this type of panel, measurement targets are unavailable.

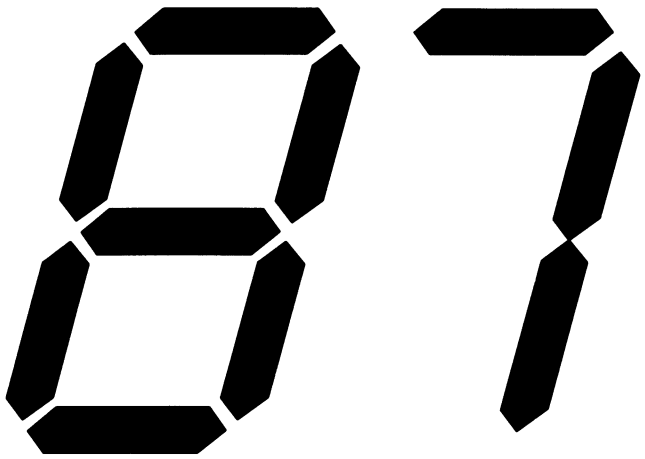

Figure 1 — Segmented display

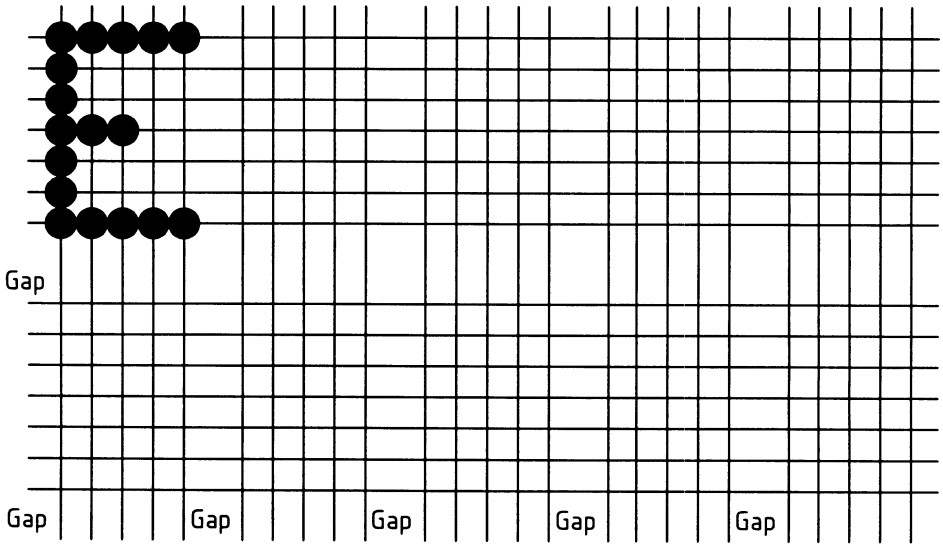

Figure 2 — Display with built-in gaps

1 Scope

This part of ISO 13406 establishes the rationale for ergonomic requirements for work with visual displays based on flat panels.

This part of ISO 13406 is applicable to flat-panel technology applied to displays for office work and similar work.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of ISO 13406. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 13406 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 9241-11:1998, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 11: Guidance on usability*.

3 Term and definition

For the purposes of this part of ISO 13406, the following term and definition applies.

3.1
flat panel

display that incorporates a flat surface > 2 m radius of curvature, for the presentation of information; the surface contains an active area consisting of a regular array of electrically alterable, discrete picture elements (pixels) in rows and columns

4 Rationale

4.1 Fitness of purpose

When the viewing direction is critical, the requirements contained in ISO 9241-3 are not sufficient for the purposes of ensuring usability (including: effectiveness, efficiency, comfort and acceptability) of a visual display. (See clause **3** of ISO 9241-11:1998 for the appropriate definitions.) For example, contrast cannot be judged normal to the screen as in ISO 9241-3 because an unsatisfactory visual display can possibly yield conforming results. Sometimes, tradeoffs that are appropriate in CRT displays are unavailable or contraindicated when flat panels are used. For example, viewing direction constraints and choice of specific colour or gray level interact on some flat panels. Reflective and transflective flat-panel displays perform better in higher ambient illuminance than tolerated by CRT and emissive flat-panel displays. Occasionally, usability requires rapid image formation time (for example, blinking or tracking of rapid cursor movement).

4.2 Measurement considerations

The viewing direction and the logical state of visual targets are specified differently, in order to measure the effect of ambient luminance and illuminance reliably and repeatably when the viewing direction is critical (applies to LCDs). This specification difference is critical for measuring luminance, contrast, colour and the coefficients needed to assess the fitness of a display to withstand reflections.

Time-dependent issues, such as the ability of a display to rapidly change an image to follow an intended cursor movement or to appear free of flicker, sometimes depend on the logical state and/or viewing direction. Measurements are needed to address this unique situation.

NOTE 1 Most CRT-based displays and some flat-panel-based displays are like a printed picture. The image does not change significantly within the normal range of viewing directions. For these displays, measuring the characteristics in only one direction, normal (perpendicular) to the surface at the centre of a specific displayed object is usual and sufficient. This is the only measurement situation considered in ISO 9241.

NOTE 2 If a display screen or printed material is viewed off-normal, the characters appear geometrically shorter. At 40°, a character appears about 25 % shorter. For single viewer displays, uniformity outside this 80° viewing cone is not required since even printed matter suffers from more severe off-angle viewing. ISO 9241-3:1992, subclause **5.3**, addresses this.

NOTE 3 Neither the electro-optical variation of the reflection coefficient nor its dependence on azimuth (viewing direction in the plane of the image) was anticipated in ISO 9241.

NOTE 4 What the user sees on many flat-panel-based computer display images depends strongly on the viewing direction. The effect is not subtle because luminance, contrast and colour points shift significantly with the viewing direction. For measurements, such displays are treated specially. The ergonomic issue is to provide a range of viewing directions centred on the design viewing direction over which all applicable specifications are verified (and usable). This type of flat panel can be fully in conformance with ISO 9241-3, but nonetheless unsatisfactory for usability and/or visual comfort. Addressing this consideration represents a major part of the deviations necessary from the ISO 9241-3 ISO 9241-7 and ISO 9241-8 basis.

NOTE 5 Some flat-panel technologies exhibit a unique time dependency of optical properties. Two significant considerations are: pixel memory and noticeably long image-formation time. The first factor complicates flicker evaluation. The second factor can lead to severe loss of contrast when the image is changing.

NOTE 6 On all complex (high pixel count) flat-panel displays, there is a chance that a few defective pixels exist or sometimes exist. This represents a new class of potential legibility problems.

NOTE 7 All flat panels exhibit the advantage of geometric and positional stability. Therefore, distortion, object size uniformity and jitter considerations in ISO 9241-3 and ISO 9241-6 do not appear in ISO 13406.

4.3 Extended uses and applications

ISO 13406-2 extends the scope of ISO 9241 to office applications with displays that are generally smaller in content.

Bibliography

[1] ISO 8995:1989, *Principles of visual ergonomics — The lighting of indoor work systems*.

[2] ISO 9241-3:1992, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 3: Visual display requirements*.

[3] ISO 9241-5:1998, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 5: Workstation layout and postural requirements*.

[4] ISO 9241-6:—, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 6: Guidance on the work environment*[1)].

[5] ISO 9241-7:1998, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 7: Requirements for display with reflections*.

[6] ISO 9241-8:1997, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 8: Requirements for displayed colours*.

[7] CIE 15.2:1986, *Colorimetry*.

[8] CIE 17.4:1987, *International Lighting Vocabulary*.

Annex ZA (normative)
Normative references to international publications with their relevant European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

Publication	Year	Title	EN	Year
ISO 9241-11	1998	*Ergonomic requirements for office work with visual display terminals (VDTs) — Part 11: Guidance on usability*	EN ISO 9241-11	1998

[1)] To be published.

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