
**Ergonomics of human-system
interaction —**

Part 304:

**User performance test methods for
electronic visual displays**

iTeh STANDARD PREVIEW
Ergonomie de l'interaction homme-système

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*Partie 304: Méthodes d'essai de la performance de l'utilisateur pour
écrans de visualisation électroniques*

ISO 9241-304:2008

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Contents

Page

Foreword	iv
Introduction.....	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Guiding principles	2
5 Conformance	2
6 Specifying the visual ergonomics test objectives	3
6.1 General	3
6.2 Criterion description	3
6.3 Measuring method.....	3
6.4 Performance criteria.....	3
7 Defining the test procedure.....	4
7.1 General	4
7.2 Alphanumeric and non-alphanumeric text.....	4
8 Visual performance and comfort test — Carrying out the test and analysing the data.....	5
8.1 General	5
8.2 Purpose	5
8.3 Overview.....	5
8.4 Test participants.....	6
8.5 The displays	6
8.6 Test setup.....	6
8.7 Dependent measures	11
8.8 Statistical treatment of results	12
8.9 Critical values for Barnard's <i>U</i> test.....	14
Annex A (informative) Overview of the ISO 9241 series	16
Bibliography.....	20

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 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 9241-304 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

This first edition of ISO 9241-304, together with ISO 9241-302:2008, ISO 9241-303:2008, ISO 9241-305:2008 and ISO 9241-307:2008, cancels and replaces ISO 9241-3:1992, of which it constitutes a technical revision. It also incorporates the Amendment ISO 9241-3:1992/Amd.1:2000, replacing that Amendment's test method with the one specified in Clause 8.

ISO 9241 consists of the following parts, under the general title *Ergonomic requirements for office work with visual display terminals (VDTs)*:

- *Part 1: General introduction*
- *Part 2: Guidance on task requirements*
- *Part 4: Keyboard requirements*
- *Part 5: Workstation layout and postural requirements*
- *Part 6: Guidance on the work environment*
- *Part 9: Requirements for non-keyboard input devices*
- *Part 11: Guidance on usability*
- *Part 12: Presentation of information*
- *Part 13: User guidance*
- *Part 14: Menu dialogues*
- *Part 15: Command dialogues*
- *Part 16: Direct manipulation dialogues*
- *Part 17: Form filling dialogues*

ISO 9241 also consists of the following parts, under the general title *Ergonomics of human-system interaction*:

- *Part 20: Accessibility guidelines for information/communication technology (ICT) equipment and services*
- *Part 110: Dialogue principles*
- *Part 151: Guidance on World Wide Web user interfaces*
- *Part 171: Guidance on software accessibility*
- *Part 300: Introduction to electronic visual display requirements*
- *Part 302: Terminology for electronic visual displays*
- *Part 303: Requirements for electronic visual displays*
- *Part 304: User performance test methods for electronic visual displays*
- *Part 305: Optical laboratory test methods for electronic visual displays*
- *Part 306: Field assessment methods for electronic visual displays*
- *Part 307: Analysis and compliance test methods for electronic visual displays*
- *Part 308: Surface-conduction electron-emitter displays (SED) [Technical Report]*
- *Part 309: Organic light-emitting diode (OLED) displays [Technical Report]*
- *Part 400: Principles and requirements for physical input devices*
- *Part 410: Design criteria for physical input devices*
- *Part 920: Guidance on tactile and haptic interactions*

For the other parts under preparation, see Annex A.

Introduction

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.

ISO 9241-3:1992, Annex C, offered users a provisional alternative method for testing the visual quality of a display, intended for novel display technologies for which no optical test method was available. The Amendment ISO 9241-3:1992/Amd.1:2000 replaced this test method and made the previously informative Annex C normative. ISO 9241-7:1998, ISO 9241-8:1997 and ISO 13406-2:2001 (all three of which have since been cancelled and replaced by other parts of the ISO 9241 “300” subseries) referred to that Amendment as providing an alternative user performance test method.

This part of ISO 9241 not only incorporates the Amendment, but extends its basis to provide guidance on the general process of assessing the visual ergonomics of displays in a specific context of use by means of a user performance test method. The test method specified in this part of ISO 9241 is applicable only to user tasks involving the handling and processing of text. However, it is expected that test procedures will also be developed for using maps and for handling and interpreting photographs and moving images, with these then being incorporated into a future edition.

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The structure of this part of ISO 9241 is an exception in the ISO 9241-300 subseries in that it establishes the conformance of a visual display used for text rendition according to its own user performance test method, instead of by means of a compliance route given in ISO 9241-307 (in which no compliance route relevant to this part of ISO 9241 is provided).

Ergonomics of human-system interaction —

Part 304:

User performance test methods for electronic visual displays

1 Scope

This part of ISO 9241 provides guidance for assessing the visual ergonomics of display technologies with user performance test methods (as opposed to the optical test methods given in ISO 9241-305). Its use will help to ensure that, for a given context of use, a display meets minimum visual ergonomics requirements. It covers only visual attributes and does not address the ergonomics or usability of the whole product that houses a visual display.

The general principles laid down by this part of ISO 9241 apply to any colour or monochrome visual display attached to a system with which human beings interact. This includes, but is not limited to, visual displays used with desktop and portable computers, those used on mobile devices such as mobile telephones, digital cameras and personal digital assistants, and status displays used on consumer electronics equipment such as printers, in-car navigation systems and microwave ovens. It extends the basic idea of the visual performance and comfort test specified in ISO 9241-3:1992/Amd.1:2000 to the use of the performance and judgment of the display end users themselves for evaluating the quality of a display, and includes a more diverse range of technologies, users, tasks and environments.

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Because of this diversity, it is not feasible for this part of ISO 9241 to stipulate a single, generic test method that can be used with all display technologies. Instead, the basic principles for generating a test method are given. This method will be valid for evaluating specific displays in specific contexts of use: the method generated according to Clause 8 is applicable only to tasks involving the handling and processing of text. No other examples are given. An essential property of the process is that it permits the verification of the usability of a visual display for a representative task, performed by representative users, taking their performance and judgment as measured quality values. It does not, however, permit the measurement of specific perceptual attributes such as luminance contrast or display flicker in isolation.

The main users of this part of ISO 9241 will be those who procure displays or who need to measure display performance during product development. Its application assumes a background in behavioural science.

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

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

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

ISO 9241-303:2008, *Ergonomics of human-system interaction — Part 303: Requirements for electronic visual displays*

ISO/IEC 8859 (all parts), *Information technology — 8-bit single-byte coded graphic character sets*

3 Terms and definitions

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

4 Guiding principles

The guiding principles of this part of ISO 9241 are that visual displays should help people carry out their tasks effectively and efficiently, and that displays should be satisfying to use and not in any way be harmful to their users' health.

Formal optical test methods as specified in ISO 9241-305 might not be available to support the procurement of newer display technologies. In such cases, requiring manufacturers to demonstrate evidence of the usability of their displays provides the most effective route for ensuring good ergonomics quality. This is the approach taken by this part of ISO 9241.

It sets out four steps for generating test methods that can be used to measure the ergonomics visual quality of visual displays:

- a) specify the visual ergonomic test objectives (see Clause 6);
 - b) define the test procedure (see Clause 7);
 - c) carry out the test (see Clause 8);
 - d) analyse the data (see Clause 8).
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5 Conformance

Whereas ISO 9241-303 and ISO 9241-305 refer to the compliance routes defined in ISO 9241-307 to establish the conformance of a visual display, this part of ISO 9241 itself specifies a test method for establishing such conformance.

If the test display is compared to a benchmark display and the test procedure is based on either alphanumeric or non-alphanumeric text, conformance is achieved when both

- the search speed for the test display is not statistically significantly lower than the search speed obtained with the benchmark display, and
- the perceived quality, as measured by its visual comfort rating, of the test display is not statistically significantly lower than that of the benchmark display.

The procedure used for determining search speed and perceived quality shall be in accordance with Clause 8.

6 Specifying the visual ergonomics test objectives

6.1 General

Visual ergonomics can be measured like any other engineering attribute. Although the data from user performance tests are derived from objective and subjective measures of human performance, this does not mean that the data are simply personal opinions. A good test design will generate data that are objective and unbiased. Useful information on many practical aspects of test design in general is given in ISO 20282; ISO 20282-1, in particular, provides valuable background information in this area.

Testing only makes sense if the test results are compared with criteria that define a display as acceptable or unacceptable. The aim of this step is to define those criteria for the display to be tested.

6.2 Criterion description

The criterion description defines the context of the measurements and the performance characteristics that will be measured. In most cases — when, for instance, a novel display technology is used in a visual display that helps perform an existing task (such as word processing in an office) — the visual quality of the test display is assessed against that of a benchmark display known to meet or exceed the requirements of ISO 9241-303, using a measuring method according to ISO 9241-305 and a conformance method according to ISO 9241-307.

EXAMPLE A test of a display that will be used for in-car navigation might use as the criterion: “Ease of reading information from the display when it is used by experienced drivers in bright ambient lighting”.

6.3 Measuring method

The measuring method describes how the criterion will be measured, i.e. the scale that will be used for the measurement and how the values will be derived.

As an example, in ISO 9241-11, three separate measures are taken:

- effectiveness (the accuracy and completeness with which customers achieve specified goals);
- efficiency (the accuracy and completeness of goals achieved in relation to resources);
- satisfaction (freedom from discomfort, and positive attitudes towards the use of the visual display).

It needs be realized that these three measures from ISO 9241-11 are context-dependent; this means that, for example, the effectiveness of a mobile phone display could be low — even very low compared to that of a desktop display — yet entirely satisfactory in the context of mobile phone use.

EXAMPLE A test of a display used on a mobile phone measures the accuracy with which a participant can distinguish different colours (effectiveness), the speed with which a participant can read text on the display (efficiency) as well as the participant's overall attitude towards the display's image quality (satisfaction).

6.4 Performance criteria

If the test display is compared to a benchmark display, the performance criterion is normally that the test display have at least the same visual quality as the benchmark one. But in other cases, making a decision on the value that is acceptable can require some market analysis. Useful questions to ask at this stage include the following.

- Is there an earlier version of the tested display that is relevant in this context? If so, how is its visual quality rated?
- How do competitors displays perform?

These values provide the engineer with a lower limit to place on the performance of the display. Human factors specialists recommend that the response range be considered as a continuum ranging from “Unacceptable”, through a “Minimum” range into a “Target” range, and finally into an “Exceeds” range, as follows.

a) Unacceptable

If the display performs within this range, it cannot be released.

b) Minimum

If the display performs within this range, it is barely acceptable. Management must weigh the benefits of releasing a barely adequate display now, versus waiting for the usability defects to be fixed.

c) Target

If the display performs within this range, it can be released. This is the performance range thought to be necessary to succeed.

d) Exceeds

If the display performs within this range, it could be that the development team have put too much effort into the design of the display and/or developed a product surpassing requirements.

This approach makes it unlikely that the development team will either under- or over-engineer the display.

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7 Defining the test procedure (standards.iteh.ai)

7.1 General

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The test procedure shall be oriented towards a task carried out with the help of a visual display: a user performance test method as defined in this part of ISO 9241 relies on a user behaving as when performing a typical task of this kind.

7.2 Alphanumeric and non-alphanumeric text

The visual performance and comfort test specified in Clause 8 may be used to establish the conformance of a visual display to a certain quality, according to user performance, applicable to tasks involving the handling and processing of text. Its test procedure is suitable for such tasks, typical of an office environment. Test methods for other types of tasks, with their appropriate devices, remain to be developed.

NOTE 1 So far, no test procedure for using maps has been developed.

NOTE 2 So far, no test procedure for handling and interpreting photographs has been developed.

NOTE 3 So far, no test procedure for handling and interpreting moving images has been developed.

8 Visual performance and comfort test — Carrying out the test and analysing the data

8.1 General

This clause specifies a method that can be used to test the visual quality of electronic visual displays where the entire set of physical requirements (viz. ISO 9241-303) cannot be applied — for example, in the case of novel display technologies such as new types of flat panel display (e.g. electroluminescent or field emission displays). The test consists of a letter search task and an assessment of visual comfort.

The context of use is *text processing*, such as that which takes place in office work. The combination of test results will be referred to as the *visual quality* of the display.

The various stages of the test, such as recruiting participants, running a pilot test and administering the final test are described (see also ISO/TS 20282-2), as is the analysis of the test data, including application of statistics.

8.2 Purpose

The method tests displays that cannot otherwise be tested for conformance with ISO 9241. It is not an alternative test method in the sense that a display manufacturer has the option of choosing either the physical requirements described in ISO 9241-303 or this method. Instead, the test method provides a testing route for displays that cannot be tested according to the requirements specified in ISO 9241-303 because the display under test uses a new technology that makes metrological measurements such as those specified in ISO 9241-305 difficult or impossible.

8.3 Overview

8.3.1 General

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This test procedure measures the effectiveness of the transfer of visual information in terms of participants' search performance for targets embedded in alphanumeric characters on a candidate display versus those same participants' performance for such a task on a benchmark display. Effectiveness in this context means that the user is able to detect and recognize the visual targets accurately, quickly and without visual discomfort. If the display passes this particular visual search and rating performance test, it can be assumed capable of other presentations of information such as, but not limited to, non-alphanumeric languages.

NOTE For a general background on this type of test methodology, see ISO/IEC 25062.

The dependent variables of the test are the search speed achieved by the test participants in a visual letter search task and subjective ratings of visual comfort using a category scale. Testing takes place in a simulated office environment, with test participants representative of the anticipated user population.

The method, i.e. a letter search task applying pseudo-text in combination with scaling of experienced visual comfort, was first developed and tested by researchers of the centre for research on user-system interaction (IPO) [12], [13].

The visual quality of a display, referred to as a test display, is assessed against a benchmark display known to meet or exceed the requirements of ISO 9241-303. Both the speed in the visual search task and the subjective ratings must meet certain minimum requirements for the test display to pass. Sequential statistics, or an equally robust equivalent statistical procedure, are used to determine if the participant's performance on the test display exceeds, is equal to, or falls short of, performance on the benchmark display.