
**Ergonomics of human-system
interaction —**

**Part 411:
Evaluation methods for the design of
physical input devices**

iTeh STANDARD PREVIEW —
Ergonomie de l'interaction homme-système —

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*Partie 411: Méthodes d'évaluation de la conception des dispositifs
d'entrée physiques*

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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.

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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/TS 9241-411 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

This first edition of ISO/TS 9241-411, together with ISO 9241-400, ISO 9241-410 and ISO 9241-420, cancels and replaces ISO 9241-4 and ISO 9241-9, technically revised as follows:

- terms and definitions from ISO 9241-4 and ISO 9241-9 have been transferred to ISO 9241-400;
- guiding principles, collected in ISO 9241-400, have been incorporated and unified so that they correspond to the scope of the new ISO 9241 series;
- test methods taken from ISO 9241-4 and ISO 9241-9 have been reviewed and amended and new test methods introduced and collected in annexes for greater convenience.

ISO/TS 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*

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- Part 5: Workstation layout and postural requirements
- Part 6: Guidance on the work environment
- 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 100: Introduction to standards related to software ergonomics [Technical Report]
- Part 110: Dialogue principles
- Part 129: Guidance on software individualization
- Part 143: Forms
- Part 151: Guidance on World Wide Web user interfaces
- Part 154: Interactive voice response (IVR) applications
- Part 171: Guidance on software accessibility
- Part 210: Human-centred design for interactive systems
- 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 310: Visibility, aesthetics and ergonomics of pixel defects [Technical Report]
- Part 331: Optical characteristics of autostereoscopic displays [Technical Report]
- Part 400: Principles and requirements for physical input devices
- Part 410: Design criteria for physical input devices

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- *Part 411: Evaluation methods for the design of physical input devices* [Technical Specification]
- *Part 420: Selection of physical input devices*
- *Part 910: Framework for tactile and haptic interaction*
- *Part 920: Guidance on tactile and haptic interactions*

The following parts are under preparation:

- *Part 391: Requirements, analysis and compliance test methods for the reduction of photosensitive seizures*

User-interface elements, ergonomic requirements for the reduction of visual fatigue from stereoscopic images, and the evaluation of tactile and haptic interactions are to form the subjects of future parts 161, 392 and 940.

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Introduction

Input devices are a means for users to enter data into interactive systems. Generally speaking, an input device is a sensor that can detect changes in user behaviour (gestures, moving fingers, etc.) and transform them into signals to be interpreted by the interactive system.

This part of ISO 9241 presents methods for the laboratory analysis and comparison of input devices for interactive systems. It does not contain requirements for input devices, but provides the means for evaluating conformance with the requirements of ISO 9241-410 for input devices such as keyboards, mice, pucks, joysticks, trackballs, touch pads, tablets/overlays, touch-sensitive screens, and styli/light pens.

The target users of this part of ISO 9241 are manufacturers, product designers and test organizations concerned with commercial input devices such as the physical input devices listed above.

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Ergonomics of human-system interaction —

Part 411:

Evaluation methods for the design of physical input devices

1 Scope

This part of ISO 9241 specifies evaluation methods for the design of physical input devices for interactive systems. It provides guidance for the laboratory assessment of conformance with ISO 9241-410 for keyboards, mice, pucks, joysticks, trackballs, touch pads, tablets/overlays, touch-sensitive screens, and styli/light pens. Its provisions apply only to keyboards identified as “full-size” or “compact” by the manufacturer, but nevertheless could provide useful guidance in the design of other keyboards. It is not applicable to those of the requirements of ISO 9241-410 that relate to gesture- and voice-input systems.

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/TS 9241-411:2012
<https://standards.iteh.ai/catalog/standards/sist/22cb0384-e154-4910-96f2-98736fdec217/iso-ts-9241-411-2012>
- ISO 7000, *Graphical symbols for use on equipment — Index and synopsis*¹⁾
- ISO 9241-5, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 5: Workstation layout and postural requirements*
- ISO 9241-307, *Ergonomics of human-system interaction — Part 307: Analysis and compliance test methods for electronic visual displays*
- ISO 9241-410:2008, *Ergonomics of human-system interaction — Part 410: Design criteria for physical input devices*
- ISO/IEC 9995-1, *Information technology — Keyboard layouts for text and office systems — Part 1: General principles governing keyboard layouts*
- IEC 60417, *Graphical symbols for use on equipment*¹⁾

1) The database on Graphical Symbols for Use on Equipment contains the complete set of graphical symbols included in ISO 7000 and IEC 60417: <http://www.graphical-symbols.info/>

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9241-400 and ISO 9241-410 and the following apply.

3.1

category

part of a system into which properties of entities can be arranged

[SOURCE: ISO 9241-410:2008; 3.2]

3.2

class

category of a property of a product with rank order

NOTE 1 Class 1 is the *most*, and class *n* the *least*, favourable category of a specific property of a product, where *n* is the number of classes.

NOTE 2 An example of a property is *durability of the legends* of a key. If a key belongs to the highest class, it will fulfil all requirements for the lower categories.

[SOURCE: ISO 9241-410:2008; 3.3]

3.3

compact keyboard

keyboard that features most properties of a full-size keyboard, with the editing section integrated into the alphanumeric section

NOTE 1 A compact keyboard has no numeric section separate from the alpha keys.

NOTE 2 Compact is a term used to describe a keyboard that allows a mouse or other pointing device to be positioned closer to the user as described in 9241-410, B.2.1.1. Some keyboards, for example keyboards with small dimensions as used on portable devices, are neither full-size nor compact keyboards.

[SOURCE: ISO 9241-410:2008, 3.4, modified — Note 1 has been changed and Note 2 added.]

3.4

full-size keyboard

keyboard that comprises all sections and zones as described in ISO/IEC 9995-1

[SOURCE: ISO 9241-410:2008, 3.6]

3.5

housing

protective cover designed to contain or support a mechanical component

NOTE An input device is either integrated into its own housing or into another unit that comprises other functional units (e.g. control desk, control panel, telephone).

[SOURCE: ISO 9241-410:2008, 3.11]

3.6

index of difficulty

I_D

measure of the user precision required in a task

NOTE The index of difficulty, I_D , is measured in bits, and is calculated for selection, pointing, or dragging tasks by

$$I_D = \log_2 \frac{d + w}{w}$$

and, for tracing tasks, by

$$I_D = \frac{d}{w}$$

where

d is the distance of movement to the target;

w is the target width of the displayed target along the approach axis for selection, pointing or dragging tasks, and perpendicular for tracing tasks.

[SOURCE: ISO 9241-410:2008; 3.12]

3.7 input device

user controlled device that transmits information to a system

[SOURCE: ISO 9241-400:2007; 3.6.3]

3.8 joystick

lever mounted in a fixed base used to control the movement of objects displayed on a screen

SEE: Figure 1.

[SOURCE: ISO 9241-400:2007; 3.6.4]



Figure 1 — Side view of example joystick

3.9 keypad

functional unit that comprises at least a group of keys dedicated and arranged for a given functionality and possibly additional keys supporting related functionality

EXAMPLE Numeric keys, “Enter” key of keypad.

[SOURCE: ISO 9241-410:2008; 3.14]

3.10 light-pen

light sensitive input device that, when pointed onto a specific location on a display, identifies its position to the system

SEE: Figure 2.

[SOURCE: ISO 9241-400:2007; 3.6.10]

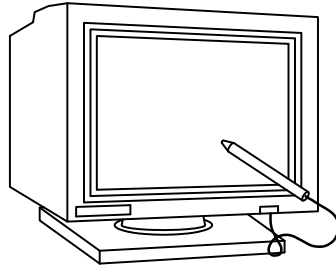


Figure 2 — Example of light-pen against display

3.11 mouse

computer input device having one or more buttons and capable of two dimensional rolling motion which can drive a cursor on the display and performs a variety of selection options or commands

[SOURCE: ISO 9241-400:2007; 3.6.11]

3.12 neutral posture

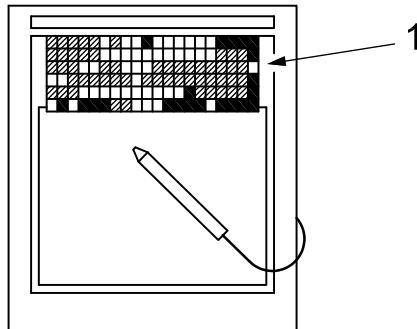
posture which avoids the extremes of a joint's range of motion or that is not near the end of the range of motion for the particular joint

3.13 overlay

thin template on the surface of a tablet used to indicate the graphic functions available to the user

SEE: Figure 3.

[SOURCE: ISO 9241-400:2007; 3.6.13] standards.iteh.ai/catalog/standards/sist/22cb0384-e154-49b0-96f2-98736fdec2f7/iso-ts-9241-411-2012



Key
1 graphic overlay

Figure 3 — Top view of example of tablet with graphic overlay

3.14 puck

hand-held device similar to a mouse but with a reticle view port and that is typically used with a digitizing tablet

SEE: Figure 4.

[SOURCE: ISO 9241-400:2007; 3.6.16]

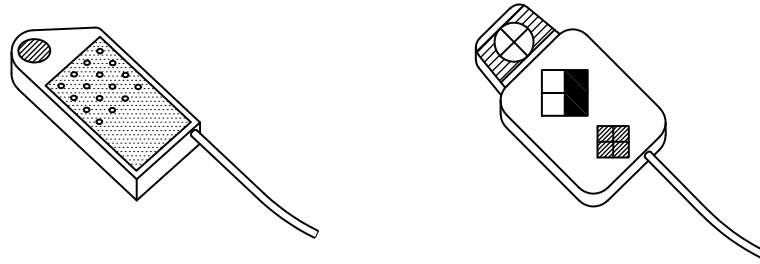


Figure 4 — Top view examples of two types of puck

3.15 section

<keyboard> functional groups within computer keyboards for which different rules for layouts can apply

NOTE Some sections of existing keyboards are arranged according to more-than-century-old conventions.

[SOURCE: ISO 9241-410:2008; 3.16]

3.16 stylus

pen-shaped pointing device which, when touched to a display or graphics tablet, can be used to draw images on a display or select displayed objects, typically by depressing the stylus tip or actuating a button located along the side of the stylus

SEE: See Figure 5.

[SOURCE: ISO 9241-400:2007; 3.6.23]

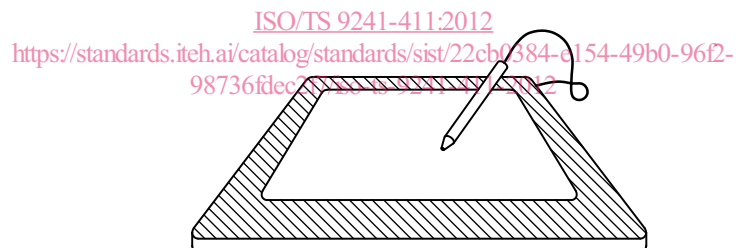


Figure 5 — Side view of example of stylus over graphics tablet

3.17 tablet graphics tablet

special flat surface with an input device (such as a stylus or puck) for selection, drawing, or indicating the position, of images to be displayed

[SOURCE: ISO 9241-400:2007; 3.6.24]

3.18 task precision

measure of the accuracy required for a pointing, selecting or dragging task primitive, quantified by the index of difficulty

[SOURCE: ISO 9241-410:2008; 3.17]

**3.19
throughput**

<input devices> rate of information transfer when a user is operating an input device to control a pointer on a display

NOTE The throughput is expressed in bits per second.

[SOURCE: ISO 9241-400:2007; 3.7.13]

**3.20
touch sensitive screen
TSS**

input device that produces a position and selection input signal from a finger touching, lifting off or moving across a display

[SOURCE: ISO 9241-400:2007; 3.6.27]

**3.21
touchpad**

touch-sensitive pad that senses the position of a finger on its surface

[SOURCE: ISO 9241-410:2008; 3.18]

**3.22
trackball**

input device consisting of a ball in a fixed housing that can be rolled in any direction by the fingers to control pointer movement

NOTE See Figure 6.

[SOURCE: ISO 9241-400:2007; 3.6.26]

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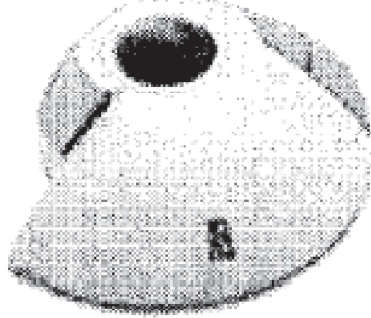


Figure 6 — Example of top view of trackball device with buttons

**3.23
zone**

<keyboard> smaller unit within a section of a keyboard representing different functionality

EXAMPLE The layout of the alphanumeric keys for entering graphic characters (alphanumeric zone) grouped with function and modifier keys such as “Ctrl”, “Alt”, “Tab” or “Backspace”.

[SOURCE: ISO 9241-410:2008; 3.20]

4 Guiding principles

A structure is needed from compliance procedures and evaluation methods for physical input devices. The aim of this structure is to clarify what requirements and classes (specified in ISO 9241-410) are relevant for each intended application.

For this purpose the evaluation methods are outlined in the Tables 1 to 20. Each table addresses different evaluation methods with three columns stating

- the clauses or subclauses referred to in ISO 9241-410, with the specific requirement being addressed,
- the pass/fail criterion based on the requirements reproduced from ISO 9241-410, and
- the recommended measuring methods to verify whether the requirement has been fulfilled.

Reporting should be done using the summarizing table shown in ISO 9241-410: 2008, Figure 1.

5 Evaluation methods

5.1 Physical input devices in general

Table 1 shows the measuring methods for physical input devices in general.

Table 1 — Measuring methods for physical input devices in general

Attribute in ISO 9241-410: 2008	Pass/Fail criterion based on requirements and intended context of use	Measuring method
Clause 5 Usable for designated purpose	The input device shall be usable for its designated purpose.	Verify the conformance with the normative design requirements in the relevant annex (ISO 9241-410:2008, Annexes B to J).
Clause 5 Satisfactory level of performance	The input device shall be usable for its designated purpose. It is considered usable if users can achieve a satisfactory level of performance on a given task and maintain an acceptable level of effort and satisfaction.	Verify the level of effort and satisfaction by measuring and demonstrating comfort using the methods in Annex C.
7.1 Specification of intended use	The intended use for a physical input device shall be specified unless it is obvious or the device is designed for general purpose use. [Modified from ISO 9241-410]	State: — that the intended use is specified; or — that the intended use is for general purposes; or — that the intended use is obvious.
7.1 Technical conditions for use	The specification shall include technical conditions for the context of use to be realized for a satisfactory use of the device (e.g. operating system, driver, support surface, etc.).	Verify that the specification of the intended use of the device states the required technical conditions for the context of use.