EN ISO 9241-9: 2000 - Ergonomic requirements for office work with visual display terminals (VDTs) - Part 9: Requirements for non-keyboard input devices

Submitted by superadmin on Mon, 10/22/2012 - 14:45
HP Activity Categories:
Design of working environment and human-machine interfaces [1]

Resource Type:
Guideline

Abstract:
This part of ISO 9241 provides requirements and recommendations for the design of non-keyboard input devices which may be used in conjunction with a visual display terminal. It applies to several types of non-keyboard input devices designed for stationary use. The standard covers such devices as the mouse, trackball and other pointing devices, but it does not address voice input. ISO 9241-9 also consists of tests that evaluate the performance, comfort, and effort required in the operation of common hand-operated devices for people without disability. The evaluation has two parts: system factors and human factors.

References

Developer and source:
ISO ? International Organisation for Standardization

Year of development / publication, updates etc:
2000

General Description

Purpose:
This part of ISO 9241 provides requirements and recommendations for the design of non-keyboard input devices. It only includes devices for which there exists sufficient published ergonomic information. This part of ISO 9241 applies to several types on non-keyboard input devices designed for stationary use. It provides guidance based on ergonomic factors for the following input devices: mice, pucks, joysticks, trackballs, tablets and overlays, touch-sensitive screens, styli, and light pens. It gives guidance on the design of these devices used for typical office tasks so that the limitations and capabilities of users are considered.

This standard provides guidance on the design of these devices so that the limitations capabilities of users, which are working in a typical office environment, are considered. It specifies methods for determining conformance through observation, performance and by measuring the physical attributes of the various devices.

Type (e.g. observation, questionnaire, interview, checklist, measurement instrument, etc.):
Guidance material, test procedures, questionnaire

**Technical description of method or tool etc**

Description of the content/study:

This part of ISO 9241 applies to several types of non-keyboard input devices including mice, pucks, joysticks, trackballs, tablets and overlays, touch-sensitive screens, styli and light pens. The standard specifies the quality of the input device in terms of a performance criterion: "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." The standard also includes a set of design requirements that first covers general requirements and recommendations (such as resolution, button design and upper extremity and head posture), and then addresses specific input device requirements and recommendations (such as mice, pucks and joysticks).

Compliance with the standard can be achieved only by carrying out a usability test. The standard has four annexes: input device selection, usability testing and analysis; testing of efficiency and effectiveness; assessment of comfort; and additional evaluation methods. Note that this standard does not cover voice input.

The norm comprises of several chapters, including:

- Definitions of the relevant terms, including descriptions of the several input devices.
- General guiding principles focusing on usability aspects.
- Requirements and recommendations, which apply generally and specific to particular input devices.
- Measurements to check whether the requirements are fulfilled. This part specifies methods for determining conformance. Mostly the test-method of choice is direct observation and simple yes/no (requirement fulfilled) decisions.

Finally, the standard includes four informative annexes that cover:

- Selection criteria for input devices, depending on the tasks to be performed. Then general recommendations for setting up test are described.
- Evaluation methods for effectiveness and efficiency. A number of representative tasks are described for evaluating computer pointing devices. These include target acquisition, pursuit tracking, freehand input, and dragging. Between-device comparisons are possible with the ISO standards because the methodology is consistent from one study to the next and thus, performance can be compared to a baseline, such as a traditional optical mouse. The metric for comparison is "throughput" in bits per second, which includes both speed and accuracy of users' inputs and is based on Fitts' law. The tests described are: one-directional tapping test, multi-directional tapping test, dragging test, path following test, tracing test, free-hand test, and grasp and park (homing) test
- Methods for assessing user satisfaction and effort. Two methods are described, where simple ratings scales are used.
- Two additional evaluation methods are briefly described, which are under examination for suitability at the time of publishing this norm: body posture analysis and biomechanical measurement based on muscle activity and tension.
- The standard also includes a bibliography with over 100 references.

The methods in the Annex are intended for developers, manufacturers, designers and people involved in procurement to evaluate the usability and ergonomic aspects of established or newly developed input devices.

Technical requirements for using the method, tool, etc:
The norm is available as paper version or electronically as a PDF document. No special technical requirements are necessary for applying the norm.

To perform the various practical tests, they need to be programmed on a suitable computer system, including a display.

Measure/Response Type:

ISO 9241-9 also includes a comprehensive qualitative evaluation, called Device Assessment Questionnaire. The questionnaire comprises 12 questions about the levels of comfort and effort that are involved in the operation of the system. It measures responses on a 7-point interval scale and can be used for within-group or between-group comparison. It assesses aspects of operation, fatigue, comfort, and overall usability.

For assessing the effort a Borg Scale is used, which is a simple method of rating perceived exertion on a 12-point scale.

Results obtained and interpretation:

The device assessment questionnaire can be applied to assess a single input device or in a comparative manner when several input devices are under investigation. Then users rate on each scale item which device is better than the other.

The Borg-scale can be used separately for different body parts or muscle groups, e.g. arm, shoulder, neck.

Both scales are interval scales, so standard statistical methods can be used.

The several practical tests for efficiency and effectiveness of a pointing device yield a metric computed by task difficulty and movement time. The metric is called throughput with unit bits/s.

**Evaluation**

Advantages:

ISO 9241-9 improves the quality and comparability of device evaluations as standard tests and questionnaires are provided.

The provided requirements and recommendations offer basic design principles easy to understand and apply.

Disadvantages:

It only includes devices for which there exist sufficient published ergonomic information. New technologies developed after the publishing of the norm, are not covered in the requirements and recommendation section.

Alternative Methods:

This standard has been revised by: ISO/TS 9241-411:2012, Ergonomics of human-system interaction -- Part 411: Evaluation methods for the design of physical input devices. It costs 172 CHF. This part of ISO 9241 specifies evaluation methods for the design of physical input devices for interactive systems and 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. As this norm is ?brand new? it was not
available while writing this report. From the information available it offers basically the same tests and questionnaires, including testing of efficiency and effectiveness, assessment of comfort, and usability test for keyboards.

The general requirements and recommendations for designing input devices are merged into ISO 9241-410:2008, Ergonomics of human-system interaction ? Part 410: Design criteria for physical input devices specifies criteria based on ergonomics factors for the design of physical input devices for interactive systems including keyboards, mice, pucks, joysticks, trackballs, trackpads, tablets and overlays, touch-sensitive screens, styli and light pens, and voice- and gesture-controlled devices. It gives guidance on the design of these devices, taking into consideration the capabilities and limitations of users, and specifies generic design criteria for physical input devices, as well as specific criteria for each type of device. Requirements for the design of products are given either as a result of context-free considerations, or else can be determined based on the specified design criteria for the intended use; such specified criteria generally having been subdivided into task-oriented categories, wherever applicable.

ISO 9241-410:2008 is expected to be used by the manufacturers of physical input devices, including product designers and test organizations, in determining the design characteristics of a device for its intended context of use (user population, task, software or environment, etc.). The data generated by the users of the norm for the description of the properties of their products can be applied in the selection of a device adequate for the actual context of use on the basis of the task primitives relevant for the task of the specific user population, and for achieving the required level of efficiency and effectiveness for a given system. It costs 196 CHF.

For choosing the right input devices the norm ISO 9241-420:2011, Ergonomics of human-system interaction: Selection of physical input devices applies, which provides guidance for the selection of input devices for interactive systems, based on ergonomic factors, considering the limitations and capabilities of users and the specific tasks and context of use. It describes methods for selecting a device or a combination of devices for the task at hand. It can also be used for evaluating the acceptability of trade-offs under the existing conditions.

The target users of ISO 9241-420:2011 are user organizations and systems integrators who tailor systems for a given context of use. It is applicable to the following input devices: keyboards, mice, pucks, joysticks, trackballs, trackpads, tablets and overlays, touch-sensitive screens, styli and light pens. It does not specify design requirements or give recommendations for those devices. This norm costs 196 CHF.


Usability (ease of use, efficiency, effectiveness)

Ease of use:
The provided requirements and recommendations are straight forward and easy to understand and interpret. Conducting the different test for evaluating effectiveness and efficiency require a medium to high level of effort.
Efficiency:
The Annex provides clear descriptions of the several tests and questionnaires. The test need to be programmed, which requires some effort.
Effectiveness:
The different test and questionnaires enables clear comparisons of different pointing devices which safeguards that the appropriate on is chosen.

Ease of use:
medium
Efficiency:
Effectiveness:
low

Constraints concerning conditions of use:

The target audience are manufacturers of non-keyboard input devices and people that need to evaluate these devices. The methods in the annex are intended for developers, manufacturers, designers and people involved in procurement to evaluate the usability and ergonomic aspects of established or newly developed input devices.

Reliability:

n/a

Validity:

n/a

Required effort (to conduct & to analyse):

Concerning the methods for assessing user satisfaction and effort while using a pointing device, the effort for conducting is rather low, as standard rating scales are used, which can be presented as paper & pencil version.

If methods for assessing the effectiveness and efficiency are used, these need to be programmed. Variations of target size and movement distance shall be considered, thus several cycles of the same type of test need to be conducted. Several different types of tests may be used, depending on the task to be performed with a pointing device. Then the results of the tests are used to calculate the ?throughput? metric (bits/s). Altogether the effort for conducting is rather high, the effort for analysis is in medium range.

Level of HF expertise needed (required user qualification)

The application of the usability methods should be performed by persons, who have the necessary knowledge of usability testing, statistical analysis and required equipment. A medium to high level is expected.

x High high level of expertise required, only for experts, lots of training required

x Medium limited level of expertise required, some training required

? Low little expertise/ training required

Other expertise needed (required user qualification):

To set-up the tests for evaluating computer pointing devices, these need to be programmed and therefore programming skills are required.

Cost Information

The ISO 9241-9: 2000 is not available any more. It was revised by ISO/TS 9241-411:2012, Ergonomics of human-system interaction -- Part 411: Evaluation methods for the design of physical input devices, which
costs 172 CHF (approx. 145 €).

Low: (<1000 €) low costs to purchase, no special devices necessary

Experiences of use by SESAR partners (including references):

not available

Reported and/or published experiences of use (including references):

not available

Applicability to lifecycle phase (E-OCVM):

The guideline is of relevance after scope and feasibility are analysed and the decision for building a certain system has been made. Thus the guideline applies for V3.

Application Area:

This norm is relevant to evaluate pointing devices in any kind of workstation.

Keywords:

Ergonomics, Office machines, Display devices, Office equipment, Computer terminals, Computer peripheral equipment, Working conditions, Computer hardware, input device, mouse, Specifications, Definitions, Visual Display Units, Metrics,

Short Description:

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