INTERNATIONAL STANDARD

ISO/IEC 29136

First edition
2012-05-01

Information technology — User interfaces — Accessibility of personal computer hardware

Technologies de l'information — Interfaces utilisateur — Accessibilité matérielle des ordinateurs personnels

Reference number
ISO/IEC 29136:2012(E)

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Published in Switzerland

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national 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 and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 29136 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 35, *User interfaces*.

Introduction

With the progress of the information society, personal computers have become a necessary tool for many people in their daily life. A wide range of people, regardless of their ages, physique, physical ability or disability, use personal computers throughout their life, i.e. at home, in school, in the workplace, and in public places. This International Standard provides guidance to improve information accessibility for older persons and persons with disabilities (including temporary disabilities) when they use personal computers.

The guidelines in this International Standard use the following approach.

- When planning, developing, designing, and distributing personal computers, this International Standard can be referenced to improve accessibility for older persons and persons with disabilities.

- If the required degree of accessibility cannot be provided by a default configuration of a personal computer, such accessibility might be attained by using the product in combination with additional software, optional equipment and/or assistive technology.

This International Standard elaborates on hardware-related guidance provided in ISO/IEC Guide 71:2001, *Guidelines for standards developers to address the needs of older persons and persons with disabilities*, ISO 9241-20:2008, *Ergonomics of human-system interaction — Part 20: Accessibility guidelines for information/communication technology (ICT) equipment and services*, and ISO/IEC TR 29138-1, *Information technology — Accessibility considerations for people with disabilities — Part 1: User needs summary*. The hardware guidance in this International Standard can be used in combination with ISO 9241-171:2008, *Ergonomics of human-system interaction — Part 171: Guidance on software accessibility*.

Information technology — User interfaces — Accessibility of personal computer hardware

1 Scope

This International Standard provides requirements and recommendations for the accessibility of personal computer hardware, to be used when planning, developing, designing and distributing these computers.

Some requirements or recommendations in this International Standard require software support.

While this International Standard does not cover the behaviour of, or requirements for, assistive technologies, it does address connectivity of assistive technologies as an integrated component of interactive systems.

Requirements and recommendations that solely focus on software are not included in this International Standard.

NOTE 1 Requirements and recommendations for software accessibility are specified in ISO 9241-171.

NOTE 2 High level requirements and recommendations for information and communication technology (ICT) accessibility are specified in ISO 9241-20.

NOTE 3 Requirements and recommendations for office equipment accessibility, including printers, scanners and copiers, are specified in ISO/IEC 10779[2].

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 9241-20:2008, *Ergonomics of human-system interaction — Part 20: Accessibility guidelines for information/communication technology (ICT) equipment and services*

ISO 9241-171:2008, *Ergonomics of human-system interaction — Part 171: Guidance on software accessibility*

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*

ISO/IEC 13066-1, *Information technology — Interoperability with assistive technology (AT) — Part 1: Requirements and recommendations for interoperability*

ISO/IEC 24786:2009, *Information technology — User interfaces — Accessible user interface for accessibility settings*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
accessibility
〈interactive system〉 usability of a product, service, environment or facility by people within the widest range of capabilities

[ISO 9241-20:2008, definition 3.1]

NOTE 1 The concept of accessibility addresses the full range of user capabilities and is not limited to users who are formally recognized as having disability.

NOTE 2 The usability-oriented concept of accessibility aims to achieve levels of effectiveness, efficiency and satisfaction that are as high as possible considering the specified context of use, while paying attention to the full range of capabilities within the user population.

3.2
assistive technology
AT
hardware or software, added to or incorporated within a system, which increases accessibility for an individual

[ISO 9241-20:2008, definition 3.2]

3.3
control
〈hardware〉 physical actuator which controls the operations of the personal computer or any function thereof

NOTE 1 There are various types of hardware controls, including multi-position controls, power on/off switches and toggle controls.

NOTE 2 A key is a specialized type of control which often involves software to achieve its purpose.

3.4
keyguard
rigid cover with holes for guiding a finger to the intended keys

NOTE Keyguards prevent the unwanted striking of keys.

3.5
personal computer
microcomputer primarily intended for stand-alone use by an individual

[ISO/IEC 2382-1:1993]

3.6
reset
initialize a main processor and restart a personal computer to a known state

3.7
usability
extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use

[ISO 9241-11:1998, definition 3.1]

4 Conformance

4.1 Applying the requirements

This International Standard contains requirements and recommendations for a variety of personal computer hardware.

All requirements in Clauses 5 – 9 shall be implemented.

4.2 Applying the recommendations

Individual recommendations in Clauses 5 - 9 shall be evaluated for their applicability to the particular product.

4.3 Evaluation of products

If a product is claimed to conform to this International Standard then the procedures used to establish the product's requirements (as identified in Clauses 4.1 and 4.2), and to evaluate the product based on these requirements, shall be specified. The level of detail of the specification is a matter of negotiation between the involved parties.

5 General requirements

5.1 Requirements related to ICT

ISO 9241-20 shall be complied with for hardware issues relating to personal computers.

5.2 Requirements related to software

ISO 9241-171 and ISO/IEC 24786 shall be complied with for issues relating to the use of software to configure and control hardware features of personal computers.

5.3 Requirements related to interoperability with assistive technologies

ISO/IEC 13066-1 shall be complied with for issues relating to personal computer hardware interoperability with assistive technologies.

5.4 Avoidance of erroneous operations and support of easy operations

5.4.1 Stability of computer cases

The pressing of buttons should not cause the computer case to topple or to slip on typical surfaces where they are intended to be used.

NOTE Clause 6.1.2 b) specifies forces for pressing buttons.

5.4.2 Positions of on/off controls

a) A control to turn on/off should be located away from other controls in order to reduce the possibility of accidental activation.

b) A control to turn the device on/off should be placed in a position where it is easy to locate and activate but not to activate accidentially.

EXAMPLE In a desktop computer the on/off control is positioned in the front of the computer case.

5.4.3 Operation of a latch

If a personal computer has a latch, the associated task (e.g. performing an operation while the latch is open) should be operable with one hand.

EXAMPLE A notebook has a latch that is used to remove the battery. This latch and the battery are designed to enable the user to remove the battery using only one hand.

5.4.4 Operation on covers and flaps

a) If personal computer hardware has a cover or a flap, it should be operable with one hand to open and close.

b) If personal computer hardware has a cover or a flap for a control, it should be designed to allow users to access the control easily.

NOTE A user may access the control with the stick holding in a mouth.

EXAMPLE The flap has many ridges to prevent slipping.

5.5 Functionality provided as hardware support

5.5.1 Turning on/off

a) A control to turn on/off shall be independent from other operations except a reset operation.

b) A control to turn on/off should be easily recognizable both visually and tactilely.

NOTE 1 ISO 24503 provides the information about tactile discernable controls, either by their shape or by tactile symbols or Braille dots. [3]

c) A control to turn on/off should be a push-button.

NOTE 2 Push-button controls assist those with reduced motor control and those using head or mouth sticks or other alternative pointing devices.

d) The response to pushing a control to turn off should be configurable by the user.

EXAMPLE The user is given the option of choosing between two possibilities for turning off the computer. It can be a short press of the turn off button or a hold and press action on the same button. The second option is useful to make sure that the user really intends to turn off the computer.

e) The on/off status should be discernible by visual, aural and tactile means.

f) The user should be able to configure the personal computer to emit a visual, tactile or aural signal when the personal computer has started and the keyboard is ready to accept input.

g) If on/off control is provided from the keyboard, it should be located in a position where it is unlikely to be accidentally activated.

5.5.2 Resetting a PC

a) A reset control shall be provided to return the computer to a known state.

NOTE 1 In many cases, a reset control and an on/off control is the same control.

b) The reset button should be a push-button control.

c) The activation time following of the reset control should be configurable.

NOTE 2 This can help to avoid accidental resets, by changing the duration to a value that is long enough to ensure that the reset was pushed intentionally.

d) A reset control should be separate from the on/off control.

EXAMPLE The on/off switch is only used for turning the computer on and off, and is not used for initiating a system reset.

NOTE 3 Although the reset control can be the same as the on/off control, it is preferable that these controls are separate in order to minimize accidental activation.

5.5.3 Consideration for consumable items

a) User replaceable consumable items (e.g. batteries) should be able to be replaced with one hand.

EXAMPLE The battery of a laptop is fixed by two latches at the right and left sides of the computer. These latches remain in the “open” or “close” state when the user slides them so the user can replace the battery using only one hand.

b) The replacement should not require movements that need tight grasping, twisting the wrist or precision gripping.

5.6 Using readable labels

a) Large (e.g. 14 point), and high-contrast (e.g. greater than 3:1) should be used.

NOTE 1 This allows users with low vision or reduced vision to more easily read the lettering.

NOTE 2 As described in ISO TR 22411:2008, Annex C, clause C.3, a font size of 14 points is the estimated minimum legible font size for text of a luminosity of 100 cd/m^2, when read by a person aged 68, and at a viewing distance of 0,5 m. [4]

NOTE 3 For calculating colour contrast, see the definitions of “contrast ratio” and “relative luminance” provided in the Web Content Accessibility Guidelines 2.0, from the World Wide Web Consortium. [5]

b) Sans-serif lettering should be used.

NOTE 4 As described in ISO TR 22411:2008, 8.6.3, a sans-serif font can increase accessibility because there will not be enough dots or pixels to render the serifs clearly. [4]

c) Text should not be overlaid upon images.

d) The labels which are essential for operating a personal computer (e.g. power switch label) should include text or symbols.

e) Tactilely distinct symbols for controls, connectors, and legends should be used.

NOTE 5 Raised symbols allow users who are blind to easily discern an item's label by touch. They also enable users to identify a component located out of view (e.g. on the back of a personal computer).

NOTE 6 Optional Braille and tactile labels enable users who are blind to customize labels.

5.7 Connection

5.7.1 Interface specification for input/output devices

A personal computer should use industry standard interfaces for supporting various types of input/output devices and AT devices.

NOTE 1 There are various types of connections, including USB, IEEE1394, Bluetooth, etc.

NOTE 2 Using standard interface specifications enables the connection of alternative input/output devices, and consequently the range of available devices to the user will be increased.

NOTE 3 Some users with sensory or cognitive disabilities, problems with language, reading, or writing, use sign language or Braille or some other means of expression. To help such users, connection to various types of software or devices used for converting and expressing language can be provided. For instance, although voice output is often used for visually-impaired users, it is also possible to convert the same content into Braille and to output it to a Braille display. Finger-Braille devices are useful for users who are deaf-blind.

5.7.2 Connectors

a) Connectors that are frequently plugged in and/or pulled out should be able to be handled with one hand.

b) Locations, colour scheme contrast and shapes of connectors that are frequently plugged in and/or pulled out should be designed for clear distinction, easy handling and prevention of inadvertent operation.

EXAMPLE A wheelchair user easily plugs in and/or pulls out the cable used to connect a printer to a personal computer, because that connector is located on the front surface.

NOTE 1 The correct orientation of a connector is easily distinguished by visual and tactile means.

NOTE 2 It is difficult to physically distinguish between sides of connectors with regular (e.g. rectangular, circular) sides (e.g. USB connectors are rectangular but have a specific orientation which might not be determined by touching their outside).

c) Misinsertion blocking should be provided.

NOTE 3 Blocking assists all users as a memory aid, but it especially helps those with low vision or cognitive impairments who might forget or misinterpret how to insert connectors.

d) The force to connect and disconnect cables and other devices should not exceed 22,2 Newtons.

NOTE 4 Users with reduced muscular strength, paralysis, tremor and involuntary movement of hands might find it difficult to connect peripheral devices.

e) Cables and their corresponding connections should be tactilely and visually distinguishable.

5.7.3 Audio port

a) An external output port for connecting an earphone or a headphone shall be provided.

b) The output from a loudspeaker of main body of a personal computer should be disabled when the external output port connects to an earphone or a headphone.

c) Audio input ports and audio output ports should be clearly distinguishable.

d) Audio input ports and audio output ports should be 3,5 mm (1/8 inch) in diameter.

e) Audio input ports and audio output ports should have a funnel-shaped surround (which makes it easier for a blind person to guide the headphone jack into the receptacle).

f) Audio input and output ports should be tactilely distinguishable.

NOTE 1 The graphical symbol for headphone is defined by IEC 60417 clause 5077. [6]

NOTE 2 The graphical symbol for microphone is defined by IEC 60417 clause 5913.

5.8 Alternative to biometric-based user authentication

If biometric-based user authentication is provided, an alternative means of identification shall be made available.

NOTE 1 Sensors which recognize the iris do not work for people affected by aniridia (lack of iris due to a congenital condition).

NOTE 2 Sensors that respond to finger contact cannot be activated by users who need to use certain assistive technology (e.g. finger/mouth/head sticks) to press controls or keys.

5.9 User comfort

a) EMI (electromagnetic interference) levels generated by a personal computer, such as radio waves and electromagnetic noise, should not affect users with hearing aids.

NOTE The ANSI/IEEE C63.19 Standard is useful to assess electromagnetic characteristics of hearing aids and personal computers for the purpose of determining compatibility. [7]

b) A personal computer should not have hard edges or sharp corners that cause injury or inhibit device placement.

c) The impact of personal computers' wireless interface to medical devices should be considered.

EXAMPLE 1 An example of such device is a pacemaker.

EXAMPLE 2 A control to stop radio transmissions from a wireless interface is provided.

6 Requirements for input

6.1 Controls

6.1.1 Perceivability

a) Controls should be easily distinguished visually.

b) Controls should be easily distinguished tactilely without being activated when they are touched.

NOTE 1 Various aspects of design include placing a symbol on/near the control and positioning the control in a predictable location.

NOTE 2 It is important to balance the needs of blind people being able to locate a control with the need for users with tremors to avoid unintentionally activating a control.

c) High-contrast of characters and symbols on controls (e.g. greater than 3:1) should be provided.

NOTE 3 Visual contrast can involve both differences in colour and in the black/white equivalent shading of the presented colour. By using contrasting shadings, people with various types of colour deficiencies are still able to distinguish between different keys or controls and the characters and symbols displayed on or near them.

d) Adequate discernable and discriminable visual shapes of characters and symbols on controls should be provided.

NOTE 4 This can be aided by using by high contrast print and a minimum height of 4 mm.

NOTE 5 Where symbols are used in labelling, the use of commonly accepted symbols can aid in recognition.

6.1.2 Operability

a) Controls should be designed in an appropriate size, shape and surface finish for easy operation by a user who uses their mouth, toe, or stick in place of their fingers.

NOTE 1 A concave surface on a control can facilitate the user targeting the control by various means including pressing with a finger or with a mouth stick.

NOTE 2 A non-slip surface on a control can help to avoid accidentally activating adjacent controls.

EXAMPLE A mouth stick used to make contact with a keyboard does not easily slip on the surface of controls.

b) The force required to activate controls should be suitable for users with disabilities and less than a maximum of 22,2 Newtons.

NOTE 3 When the pressing force or stroke of a control is too great, users with reduced muscular force might suffer excessive burden. On the contrary, when the pressing force or stroke is too small, users with tremors and involuntary movement of the hands might make unintentional input.

c) Controls should support the addition of guards to prevent unintended activation of the control.

6.1.3 Status indication

The current status of all controls should be visually discernable and discernable either through touch or sound.

NOTE Such status might be displayed on the surface of equipment by using illuminated indicators.

EXAMPLE When the control for the saving mode is pushed, the indicator lights.

6.1.4 Feedback

When controls are activated, feedback should be available in at least two modalities (e.g. tactile, visual, or auditory).

NOTE The ability to provide all three modalities of feedback can increase accessibility.

EXAMPLE When controls are activated, the user selects the preferred modality (modalities) of response from: tactile, visual, and/or auditory.

6.2 Keyboard

6.2.1 Keyboard Layout

a) Keyboard layouts should comply with ISO/IEC 9995-1.

NOTE 1 Compliance with ISO/IEC 9995-1 will provide users with consistent expectations.

b) Each logical functional group of keys should have a distinctive colour.

NOTE 2 ISO/IEC 9995-1 provides information on key groups.

c) When the assignment of the key functions is changed, the key caps should be changed according to the assignment.

d) When keys have marks (a label, a stamp, a projection, etc.), the mark should be able to be changed by users.

EXAMPLE The function of the “Escape” key located at the upper left side can be assigned to one of keys with low frequency in use arranged on the right side for users who can use only their right hand.

6.2.2 General requirements for keys

The requirements of ISO 9241-410:2008, *Ergonomics of human-system interaction — Part 410: Design criteria for physical input devices*, Annex B should be applied.

6.2.3 Perceivability of keys

a) High-contrast of characters and symbols on keys (e.g. greater than 3:1) should be provided.

NOTE Visual contrast can involve both differences in colour and in the black/white equivalent shading of the presented colour. By using contrasting shadings, people with various types of colour deficiencies are still able to distinguish between different keys or controls and the characters and symbols displayed on or near them.

b) Adequate discernable and discriminable visual shapes of characters and symbols with a minimum height of 4 mm should be provided on keys.

6.2.4 Operability of keys

Keys should be designed in an appropriate size, shape and surface finish for easy operation by a user who uses their mouth, toe, or stick in place of their fingers.

NOTE A non-slip surface on a key can help to avoid accidentally activating adjacent keys.

6.2.5 Status indication of keys

The current status of all keys should be discernable by visual, tactile and/or auditory means.

NOTE "Caps Lock", "Num Lock" and other keys whose status alternate whenever they are pressed could inform users of their present status by some means.

6.2.6 Braille equivalence functionality

A keyboard should be able to accept simultaneous push of six keys in order to enter Braille or finger Braille.

NOTE For English language keyboards the "F", "D", "S", "J", "K", and "L", keys are typically used for six-point Braille. It would be better, however, to enable the simultaneous keying of seven keys including the space key. Other language keyboards might be different.

6.2.7 Marking tactile dots or bars

Reference keys shall have tactile dots or bars.

NOTE 1 In occidental keyboard layouts, the reference keys are "F","J" in alphabetical keys and "5" in numerical keypads.

NOTE 2 While auditory marking of reference keys is not provided by hardware, keyboard software might provide this feature. ISO/IEC 9995 series has provisions to associate a sound signal to marked keys ("F", "J", and numeric keypad "5" on occidental layouts).

6.2.8 Keyguard

Keyboards should permit the attachment of a keyguard.

NOTE If a keyguard is attached to the keyboard, users with reduced muscular strength who cannot hold their hands above the keyboard, have tremors or involuntary movement of hands or those who use a head, mouth, or hand stick will be able to activate keys only when they wish so.

6.2.9 Connection of additional keyboards

a) A personal computer should be able to support at least two keyboards, and be operated by both of them.

NOTE 1 If special keyboard is provided as the main keyboard to meet the user's requirements, the original keyboard can be used as sub-keyboard.

NOTE 2 When the user with disability and the assistant use a personal computer at the same time, the assistant might not operate the keyboard as a sub keyboard efficiently due to special customization for the user.

b) A personal computer should have a keyboard which is separate from the computer case or, where the keyboard is integral part of the unit, a means to connect an additional external keyboard.

NOTE 3 An external keyboard can be placed wherever it suits the user or can be replaced by an alternative input device.

c) A personal computer should be designed to permit the connection of various types of keyboards, including adaptive keyboards or other alternative input devices.

6.3 Touch screen

6.3.1 Alternative to touch input

Personal computers with touch screens shall support alternative input methods.

NOTE This allows users who cannot use the touch screen and can only use the keyboard.

EXAMPLE Voice activation is used as an alternative to some touch screen devices.

6.3.2 Separation of navigation and activation in touch input

Personal computers with touch screens should support a touch-based input mode in which navigation is separated from activation.

NOTE This mode is usually provided by software, but the hardware has to support the separate input methods.

EXAMPLE A personal computer with a touch screen provides a mode in which a single tap selects user interface objects (providing auditory information of its meaning) and a double tap activates the object.

7 Requirements for output

7.1 Visual information

7.1.1 External visual display

A personal computer shall either have a visual display that is separate from the computer case or have a mechanism to connect an additional external display.

NOTE It will be possible to place it in a position that suits the user or it can be replaced by another display better suited to the user's needs.

7.1.2 Visual display position

If a visual display has a mechanism to adjust its position (e.g. angle, swivel, height, tilt), then it shall be adjustable by one hand and shall not require movements that need tight grasping (maximum force 22,2 Newtons), twisting the wrist or precision gripping.

NOTE Users with limited manual ability might not have enough manipulation and coordination capacity or strength to make these movements.

7.1.3 Controls for visual display adjustment

The full range of colour, brightness, and contrast on a visual display should be controllable by both physical controls and software.

7.1.4 Display subtitles / captions

If a personal computer or a display is equipped with a broadcasting television receiver, it should be able to receive and process the broadcast subtitles / captions.

NOTE Subtitles can be provided for linguistic purposes and/or to aid the deaf and hard of hearing.

7.1.5 Screen resolution

a) A visual display should have a sufficient screen resolution to allow users to better see detailed outputs.

b) A visual display should have a screen resolution to allow users to discriminate sign language or finger-spelling outputs.

c) The screen resolution should be adjustable.

NOTE 1 Users with hearing disabilities often use sign language as their main means of communication, and might have trouble in understanding text-only content.

NOTE 2 The changes of a mouth and face are very helpful to understand sign language, so high screen resolution and high frame speed are better for it.

7.2 Auditory information

7.2.1 Placement of speakers

When speakers are integrated with other components (e.g. as part of a notebook computer, or as part of a visual display) they should be placed so that they will be directed towards the user under normal usage conditions.

7.2.2 Audio volume

a) The full volume range should be controllable both by a physical control and by software.

b) A personal computer should be capable of a volume level of at least 65 dB SPL (Sound Pressure Level) RMS (Root-Mean-Square) at a typical listener position.

EXAMPLE When two people are talking, at about a meter from each other, the average speech level is 65-70 dB SPL.

7.2.3 Speech speed and pitch adjustment

If a personal computer generates speech output:

a) A control for adjusting speed and pitch should be provided.

b) A control for repeating the last speech output should be provided.

NOTE 1 With this feature, the user will be able to adjust the output to their tastes, needs or habits. It is also useful to have a method for adjusting other voice parameters such as accent, gender, etc.

NOTE 2 This allows a user with auditory disabilities to slow down the audio speed.

7.2.4 Consideration for audio environment

A personal computer should have a physical mute control that can be used to turn off its audio output independent of volume controls.

NOTE 1 A mute control can disable the sound without changing the volume level and recover it with one operation.

NOTE 2 This enables a user with a hearing impairment to both mute the volume and to notify a personal computer that audio output will not be received.

8 Requirements for data storage devices and removable drives

8.1 Insertion and removal of a media and change of a drive

a) Insertion and removal of storage media drives shall be able to be handled with one hand and without movements that need tight grasping (maximum force 22,2 Newtons), twisting the wrist and precision gripping.

b) Removable drives should be placed where they are easily reached and used without difficulty.

EXAMPLE 1 They are located at the front of a personal computer.

c) Media should be easily inserted and ejected.

EXAMPLE 2 Optical disk drives can use a sliding (loading/unloading) tray to insert and to eject optical media. With this feature, users with limited manual ability can easily insert the media using the tray.

d) The force required for inserting and retrieving media should be minimized.

NOTE 1 This assists those with reduced strength and grasp capabilities. A maximum force of 2 Newtons is advised, but it is preferable for the mechanism to suck the disk in for insertion and to not require a force of more than 2 Newtons for pulling it out of the slot.

e) Ejection of media should be done at a sufficient distance for grasping.

NOTE 2 Ejecting 0.5 to 0.75 inch or more is helpful for those with reduced hand functions.

f) If a drive is replaceable, it should be able to be completed using one hand.

g) Media misinsertion blocking should be provided.

NOTE 3 Blocking assists all users as a memory aid, but it especially helps those with low vision or cognitive impairments who might forget or misinterpret how to insert media.

h) The slot for media and/or a drive should be designed for users with visual disabilities.

NOTE 4 Users with visual disabilities use tactile cues, or high contrast components, to find slots for inserting media and other devices.

8.2 Notification of media insertion

a) Personal computers should notify users by visual and audible means whenever a medium is correctly inserted.

b) When it is not possible to block misinserted media, personal computers should notify users by visual and audible means whenever a medium is incorrectly inserted.

NOTE With this feature, users with vision or hearing impairments are warned that the medium will not work correctly as inserted.

9 Requirements for user support

9.1 Product information

9.1.1 General

a) Product information shall be provided with the product, or upon request on a timely basis and without extra cost.

b) Online help should be provided.

NOTE Online help allows users to access information without having to refer to manuals.

9.1.2 Form

a) Product information shall be delivered in an electronic form.

NOTE 1 This enables generation of Braille, speech, and variable-sized text outputs for users with blindness, low vision, and cognitive or physical disabilities.

b) Printed product information should be provided in alternative formats such as large print or Braille.

NOTE 2 This allows users with blindness or low vision access to the information.

NOTE 3 Suitable large print is 18-point sans-serif.

c) Printed product information shall be bound in a way that allows the manual to lie open without user intervention.

NOTE 4 A manual that lies flat is easier to manipulate by the user who has one hand or uses a mouthstick.

9.1.3 Content

a) The text content of the product information should not require reading ability more advanced than the lower secondary education level after removal of proper names and titles.

NOTE 1 The use of technical terms is permitted where necessary for clearly explaining the functionality or product.

NOTE 2 The lower secondary education level consists of the two or three year period of education that begins after completion of six years of school and ends nine years after the beginning of primary education (this definition is based on the International Classification of Education from UNESCO). [8]

b) If product information includes graphical information, it should provide text descriptions of graphical information.

NOTE 3 Written descriptions of illustrations, graphs, and so on allow users with blindness or low vision to access the information in the graphic.

c) Contrast between texts and background in manuals shall be more than 3:1.

NOTE 4 Users with colour blindness or low vision require high contrast to access printed information.

d) Product information should use colour schemes that are available for users.

NOTE 5 The ability for colour schemes is different between users with colour vision deficiencies.

e) If product information is the electronic document, its colour schemes should be changeable by users.

NOTE 6 Different colour schemes are used for users with colour vision deficiencies.

f) Product information should use colours that reproduce well on copy machines.

NOTE 7 It is important to avoid colours that copy all gray or low contrast. Users with low vision often enlarge the information in manuals using a copy machine.

g) Conveying information by colour alone shall be avoided.

NOTE 8 Users with low vision or colour blindness may have difficulty perceiving certain colours. Users who are blind scan the documentation to convert it to ASCII text.

h) Accessibility information of products should be written in the same section.

9.2 Disclosure of information to distribution channel

Information on accessibility of personal computers should be supplied to retailers, information service providers and support providers as far as possible.

NOTE Information can answer various kinds of inquiries (e.g. product specification, availability of combination with products of other companies, Q & A, know-how about usage, consideration, etc.).

9.3 Customer support

a) Customer support should accommodate the communication needs of users with disabilities.

b) Customer support should provide information in multiple formats including text, audio, and video.

NOTE 1 Fax or e-mail, etc. might be effective for users with auditory and language disabilities who find it difficult to inquire by telephone.

NOTE 2 Telephone counseling might be effective for users with visual disabilities, where presentation of information on Web sites is not sufficient.

NOTE 3 Customer support staff has enough knowledge about all available information of the product and its accessibility features.

9.4 Maintenance information

Information on upgrades and defects should be provided to users in accessible formats.

EXAMPLE A warning of exploding batteries is provided in an accessible format.

NOTE In order for users to effectively use the purchased personal computer and its peripheral device according to its purpose, environment, degree of disabilities, etc., a variety of information on products is necessary. Therefore, it is important to widely offer information on upgrades and defects, through a customer support centre, e-mail, web, etc.

Annex A
(informative)

Sample procedure for assessing applicability and conformance

A.1 General

This Annex provides an example of a checklist (see Table A.1) that can be used to determine whether the applicable requirements of this International Standard have been met and its recommendations followed.

The checklist can be used either during product development or in the evaluation of a completed product.

The checklist contains all requirements and recommendations from this International Standard, presented in sequence.

It should be noted that the procedure described is itself provided as guidance and is not an exhaustive process to be used as a substitute for the standard itself.

Use of the checklist provides a basis for:

— determining which of the requirements and recommendations are applicable,

— determining whether applicable requirements have been adhered to or recommendations followed, and,

— providing a list in support of a claim of conformance showing that all applicable requirements have been met and all the applicable recommendations followed.

The majority of the requirements are applicable to all personal computers if it is intended to enable use by people with the widest possible range of capabilities. However, in some circumstances what is needed to make the personal computer accessible depends upon the context of use (users, tasks, environment, and the technology). Where a conditional "if" appears in either a requirement or a recommendation, it is necessary to determine whether or not the context of use in which the personal computer is, or is intended to be, used, is included within the conditions covered by the "if" statement. For each context-dependent requirement or recommendation, information on applicable circumstances is given in the clause/subclause. If the conditional statement does not apply and thus the requirement or recommendation is not applicable, this should be noted in the relevant column in the applicability section of the table, and a brief explanation should be provided in the "Reason not applicable" column.

The next step involves determining whether the personal computer being evaluated conforms to each requirement or recommendation (as applicable). The exact method for making this decision could vary from an inspection-based judgment of whether a feature is or is not present to testing the personal computer with users. Whatever the method of evaluation considered most appropriate, the checklist provides space to give an indication of the level of conformity as well as observations on the method used or the judgment, which can be entered in the "Comments" column.

The completed checklist can be used in support of statements relating to conformance of the personal computer with this International Standard.

A.2 How to use the checklist

Clause numbers and titles are presented in the first two columns of Table A.1.

The third column is used to indicate whether the requirement or recommendation in each clause/subclause is applicable or not. All those that have no conditions attached to them already have a “Y” (for “Yes”) inserted in the third column to show that they are applicable, while “C” indicates applicability unless the specified conditions apply.

All other subclauses need to be checked in relation to the design context of the specific personal computer being developed or assessed. It should be noted that some requirements for which there is a conditional statement will need to have column three completed.

In addition, the applicability of all the recommendations should be checked and “Y” or “N” entered in column three, as appropriate.

Where a requirement or recommendation is not applicable, a brief note giving the reasons should be inserted in column four.

When checking whether a requirement or recommendation has been satisfied, it will be necessary to review all those items indicated as being applicable in column 3.

There should be an entry in the relevant place in column five, six or seven, showing whether each applicable requirement or recommendation has been satisfied (“Yes”), partially satisfied (“Partially”) or not satisfied (“No”). Any clause/subclause which is either judged to be partially satisfied or not satisfied should be accompanied by a brief note explaining the reasons why this is the case.

Table A.1 — Checklist for assessing applicability and conformity with ISO/IEC 29136

Clauses/subclauses of ISO/IEC 29136	Applicability		Conformance			
	Yes/No	Reason not applicable	Yes	Partially	No	Comments
5 General requirements						
5.1 Requirements related to ICT	Y					
5.2 Requirements related to software	Y					
5.3 Requirements related to interoperability with assistive technologies	Y					
5.4 Avoidance of erroneous operations and support of easy operations						
5.4.1 Stability of computer cases						
5.4.2 Positions of on/off controls						
a) on/off control located away from other controls						
b) on/off control placed easy to locate and activate						
5.4.3 Operation of a latch						
5.4.4 Operation on covers and flaps						
a) cover or a flap operable with one hand						
b) cover or a flap for a control designed to allow users to access the control easily						
5.5 Functionality provided as hardware support						
5.5.1 Turning on/off						
a) on/off control independent from other operations except a reset operation	Y					
b) on/off control easily recognizable both visually and tactilely						
c) on/off control a push-button						
d) response to an off control configurable by the user						
e) on/off status discernible by visual, aural and tactile means						
f) configure the PC to emit a visual, tactile or aural signal						

Clauses/subclauses of ISO/IEC 29136	Applicability		Conformance			
	Yes/No	Reason not applicable	Yes	Partially	No	Comments
g) On/off control unlikely to be accidentally activated						
5.5.2 Resetting a PC						
a) reset control provided to return the computer to a known state	Y					
b) reset button a push-button control						
c) activation time following of the reset control is configurable						
d) reset control separate from the on/off control						
5.5.3 Consideration for consumable items						
a) user replaceable consumable items replaceable with one hand						
b) replacement does not require movements involving tight grasping, twisting the wrist or precision gripping						
5.6 Using readable labels						
a) labels use large points, and high-contrast						
b) labels use sans-serif lettering						
c) text labels not overlaid upon images						
d) essential labels include text or symbols						
e) tactilely distinct symbols for controls, connectors, and legends						
5.7 Connection						
5.7.1 Interface specification for input/output devices						
5.7.2 Connectors						
a) frequently used connectors handled with one hand						
b) frequently used connectors designed for clear distinction, easy handling and prevention of inadvertent operation						
c) misinsertion blocking						
d) force to connect and disconnect cables and other devices does not exceed 22,2 Newtons						
e) cables and connections tactilely and visually distinguishable						

Clauses/subclauses of ISO/IEC 29136	Applicability		Conformance			
	Yes/No	Reason not applicable	Yes	Partially	No	Comments
5.7.3 Audio port						
a) external output port for connecting an earphone or a headphone	Y					
b) output from a loudspeaker disabled when the external output port connects to an earphone or a headphone						
c) audio input ports and audio output ports distinguishable						
d) audio input ports and audio output ports 3,5 mm in diameter						
e) audio input ports and audio output ports have a funnel-shaped surround						
f) audio input ports and audio output ports tactilely distinguishable						
5.8 Alternative to biometric-based user authentication						
5.9 User comfort						
a) EMI levels generated by a personal computer do not affect users with hearing aids						
b) no hard edges or sharp corners that cause injury or inhibit device placement						
c) impact of a wireless interface to medical devices considered						
6 Requirements for input						
6.1 Controls						
6.1.1 Perceivability						
a) controls easily distinguished visually						
b) controls easily distinguished tactilely without being activated when they are touched						
c) high-contrast of characters and symbols on controls						
d) discernable and discriminable visual shapes of characters and symbols on controls						