
Ergonomics data for use in the application of ISO/IEC Guide 71:2014

*Données ergonomiques destinées à être utilisées dans le cadre de
l'application du Guide ISO/IEC 71:2014*

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[ISO/TR 22411:2021](https://standards.iteh.ai/catalog/standards/iso/3878c6d7-647b-41a1-809f-74f16aa96800/iso-tr-22411-2021)

<https://standards.iteh.ai/catalog/standards/iso/3878c6d7-647b-41a1-809f-74f16aa96800/iso-tr-22411-2021>



iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[ISO/TR 22411:2021](https://standards.iteh.ai/catalog/standards/iso/3878c6d7-647b-41a1-809f-74f16aa96800/iso-tr-22411-2021)

<https://standards.iteh.ai/catalog/standards/iso/3878c6d7-647b-41a1-809f-74f16aa96800/iso-tr-22411-2021>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Supporting ISO/IEC Guide 71 with human data	2
5 Data selection and format	3
5.1 Data selection	3
5.2 Data format of this document	4
5.3 How to use the data	5
6 Sensory characteristics and capabilities	5
6.1 Overview of sensory characteristics and capabilities	5
6.2 Vision	6
6.2.1 Visual sensitivity to colour (spectral sensitivity of the eye: ageing effect)	6
6.2.2 Colour category (spans of fundamental colour, young people, older people, and people with low vision)	9
6.2.3 Colour category (international comparison)	22
6.2.4 Contrast sensitivity (young people, older people and people with low vision)	25
6.2.5 Contrast for legibility (ageing effect)	28
6.2.6 Visual acuity (effects of age, viewing distance and luminance)	32
6.2.7 Minimum font size for legibility (effects of age, viewing distance and luminance)	35
6.2.8 Minimum font size for legibility (international comparison)	37
6.2.9 Minimum font size for legibility (low vision)	41
6.2.10 Disability glare (ageing effect)	44
6.2.11 Useful field of view (ageing effect)	47
6.2.12 Lighting level and visual performance (ageing effect)	52
6.2.13 Visibility of an indicator lamp: Context and task specific data (effects of ageing and low vision)	55
6.3 Hearing	58
6.3.1 Hearing-sensitivity decrease as a function of age	58
6.3.2 Tone perception in quiet conditions (ageing effect)	60
6.3.3 Sensitivity to low-frequency tones (ageing effect)	62
6.3.4 Equal-loudness-level contours (ageing effect)	64
6.3.5 Tone perception in noisy conditions (ageing effect)	67
6.3.6 Sound pressure level of spoken announcements in public space (ageing effect)	70
6.3.7 Audible conditions for speech communication in a noisy environment (ageing effect)	72
6.4 Touch	75
6.4.1 Tactile pressure sense and spatial resolution (ageing effect)	75
6.4.2 Tactile spatial resolution (people with visual disabilities)	77
6.4.3 Tactile spatial resolution (body location and ageing effect)	78
6.4.4 Tactile temporal resolution (sensitivity to vibration, ageing effect)	81
6.4.5 Legibility of tactile symbols and characters (effects of ageing and experience in the use of tactile symbols and characters for people with visual disabilities)	83
6.4.6 Legibility of tactile symbols and characters (international comparison)	85
6.5 Thermal sense	88
6.5.1 Surface temperature (ageing effect)	88
6.5.2 Air temperature (ageing effect)	89
6.5.3 Thermal comfort (physical disabilities)	92
7 Physical characteristics and capabilities	99

7.1	Overview of physical characteristics and capabilities	99
7.2	Physical characteristics related to body size	101
7.2.1	Basic body size (design range from small to large size)	101
7.2.2	Grip diameter (ageing effect)	104
7.3	Movement – fine hand use abilities	106
7.3.1	Hand steadiness (ageing effect)	106
7.3.2	Eye-hand coordination (dexterity, ageing effect)	107
7.4	Movement – functions of upper body structure	110
7.4.1	Reach range (effects of ageing and stature)	110
7.4.2	Reach range (graspability, female 5 th percentile of body size)	115
7.4.3	Reach range in three dimensions of height, forward distance (depth), and left-right width for older people and people with disabilities (rheumatism and Parkinson's disease)	117
7.4.4	Rotation: pronation and supination (ageing effect)	120
7.5	Movement – Functions of lower body structure	123
7.5.1	Step height (ageing effect)	123
7.5.2	Step height: Subjective evaluation of physical load (ageing effect, international comparison)	126
7.5.3	Tread depth of stairs (ageing effect)	128
7.5.4	Walking speed (ageing effect)	130
7.5.5	Slope of ramps and wheelchair operation (physical disabilities)	133
7.6	Muscle strength and muscle endurance	134
7.6.1	Grip force of the hand (ageing effect)	134
7.6.2	Pressing force of the thumb	136
7.6.3	Compressive force of the index finger	138
7.6.4	Operating torque in four different conditions	140
7.6.5	Grip strength (ageing effect)	144
7.6.6	Lifting strength (gender effect)	147
7.6.7	Lifting strength (effects of age and gender)	150
7.6.8	Pushing force with two hands (ageing effect)	152
7.6.9	Pulling force with one hand (ageing effect)	154
7.6.10	Pushing force with a finger (ageing effect)	156
7.6.11	Static torque with two hands (ageing effect)	158
7.6.12	Torque and force for opening packages (effects of ageing and disabilities)	160
7.6.13	Jar opening (perceived effort, older women)	164
7.6.14	Upper extremity muscle strength (ageing effect)	166
8	Cognitive characteristics and capabilities	170
8.1	Overview of cognitive characteristics and capabilities	170
8.2	Attention	171
8.2.1	Selective attention (selective listening, effect of age)	171
8.2.2	Dual task performance (task complexity, ageing effect)	175
8.2.3	Memory under dual task conditions (effects of dual tasks and ageing)	177
8.3	Information processing	180
8.3.1	Processing speed and capacity	180
8.4	Memory	182
8.4.1	Effects of ageing and cognitive disabilities on memory	182
8.5	Language and literacy	184
8.5.1	Language use (ageing effects)	184
	Annex A (informative) Additional textual descriptions of figures	186
	Bibliography	234

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 122, *Ergonomics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO/TR 22411:2008), which has been technically revised.

The main change compared to the previous edition is the replacement of ergonomics data on human abilities and capabilities with new or more elaborated data for use in the application of ISO/IEC Guide 71:2014.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is intended to help standards developers by providing ergonomics data related to human characteristics and capabilities to support ISO/IEC Guide 71:2014. This document is supposed to be used mainly by standards developers, but also by those responsible for design. The underlying idea is that products, services and environments encountered in all aspects of daily life and intended for the consumer market and the workplace should be designed to be accessible for people with a widest range of capabilities. This idea, called accessibility, has been spreading all over the world.

ISO/IEC Guide 71 was first published in 2001 to successfully address the importance of being aware of the needs of older persons and persons with disabilities and to direct the attention of standards developers to these needs when they draft or revise standards. In response to the publication of ISO/IEC Guide 71, ISO/TR 22411:2008 was developed to fulfil the gap between the concept and practice with offering ergonomic knowledge and data on human abilities.

After more than 10 years from the publication of ISO/IEC Guide 71 and ISO/TR 22411, together with new knowledge and experience in implementing these documents, ISO/IEC Guide 71 was revised into a more elaborated one and consequently the revision of ISO/TR 22411 was required.

This document provides updated ergonomics data as well as newly available data which are all publicly available and can be used to support standards developers in applying ISO/IEC Guide 71:2014 in their individual standards. These ergonomics data help standards developers to understand characteristics and capabilities of diverse users to be served by requirements and recommendations in a standard. The data provided in this document apply mainly to persons with disabilities and older persons. The intention in using these data is to formulate requirements and recommendations in standards that include the widest possible range of users. It can also be used by designers in order to increase accessibility as part of accessible design or universal design.

While the data covers a wide area of human abilities related to accessibility, data for some part of the area, for example cognitive abilities, is still missing. Furthermore, new data emerged or were updated during the development of this document, which is not included in this document either. This document, due to scientific reasons, does not necessarily adopt the ICF terminology but established terms in ergonomics.

[ISO/TR 22411:2021](https://standards.iteh.ai/iso-tr-22411-2021)

<https://standards.iteh.ai/catalog/standards/iso/3878c6d7-647b-41a1-809f-74f16aa96800/iso-tr-22411-2021>

Ergonomics data for use in the application of ISO/IEC Guide 71:2014

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This document provides ergonomics data for standard developers to use in applying ISO/IEC Guide 71:2014 to address accessibility in standards. These data can also be used by ergonomists and designers to support the development of more accessible products, systems, services, environments, and facilities.

The ergonomics data include quantitative data and knowledge about basic human characteristics and capabilities as well as context-specific and task-specific data, all being based on ergonomics research. The data focused on the effects of ageing and/or consequences of various types of human sensory, physical, and cognitive disabilities. It does not contain general ergonomics data that have no direct relation to ageing or disabilities.

The data presented in this document are not exhaustive due to no available data for some aspects of human characteristics and capabilities with regard to ageing and disabilities.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 accessibility

extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of user needs, characteristics and capabilities to achieve identified goals in identified contexts of use

Note 1 to entry: Context of use includes direct use or use supported by assistive technologies.

[SOURCE: ISO 9241-112:2017, 3.15]

3.2 accessible design

design focused on diverse users to maximize the number of potential users who can readily use a system in diverse contexts

Note 1 to entry: This aim can be achieved by (1) designing systems that are readily usable by most users without any modification, (2) making systems adaptable to different users (by providing adaptable user interfaces) and (3) having standardized interfaces to be compatible with assistive products and assistive technology.