ISO/IEC JTC 1 Special Working Group on Accessibility (SWG-A)

JTC 1 SWG-A N 530

2012-11-20

Document Type:	Report
Title:	**ISO Guide 71 Update - Report to November 2012 JTC 1 SWG on Accessibility Teleconference**
Source:	JTC 1 SWG on Smart Grid Convenor
Due Date:	n/a
Requested Action:	For consideration at the November 2012 the JTC 1 SWG on Accessibility teleconference.

JTC 1 SWG on Accessibility Secretariat
ITI/INCITS
1101 K Street NW, Suite 610, Washington, DC 20005
jgarner@itic.org

Summary note about the first draft of Guide 71 from the convenor

The development of Guide 71 is proceeding forward at a reasonable pace with most of the work done during but not between plenary meetings. Thus far, the most mature portion of the draft is chapter 6 and 7. Members of the SWG-Accessibility are invited to send me feedback especially on these two chapters. While it would still be valuable to receive input on the rest of the draft, there is little certainty as to which part of the remaining draft will survive. The current draft is deemed too long as it stands, with portions of it still to be drafted. I anticipate substantial revision and removal of content as a result.

Based on my observation of the Guide's development, I believe it is unlikely that any of the update would lead to significant update in the part of User Needs Summary. Where the User Needs Summary directly reference Guide 71 content, there will probably be some degree of renumbering. But substantive rewrite is not likely to be necessary.

All best,

Alex Li
ISO/IEC JTC1 SWG-Accessibility Convenor

JTAG Guide 71 N133

GUIDE 71

Guidelines for incorporating accessibility in standards

[NOTE: THIS IS THE FIRST DRAFT COMBINING THE INPUTS FROM THE JTAG TASK FORCES & INCLUDES UPDATES MADE DURING THE THIRD JTAG-MEETING, 2012-10-23/25]

[CIRCULATED ON: 2012-11-06]

NOTE: Text marked as [NEEDS UPDATING/REVIEW] is original text from the 2001-edition of Guide 71 and has not yet been reviewed by the JTAG]

Second edition 2013

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

Page

Foreword [NEEDS UPDATING/REVIEW]

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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

Draft Guides adopted by the responsible Committee or Group are circulated to national bodies for voting. Publication as a Guide 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 Guide 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 Guide 71 was prepared by the ISO/IEC JTAG (Joint Technical Advisory Group) based on the work undertaken by the ad hoc TAG at the request of the ISO/TMB and the IEC SMB.

0 Introduction [NEEDS UPDATING/REVIEW]

0.1 It is an important goal for the whole of society that all people have access to products, services, workplaces and environments. The issue of accessibility to and usability of products and services has become more critical with the increasing percentage of older persons in the world's population. While not all older persons have disabilities, the prevalence of disability or limitations is highest among this demographic group.

0.2 The needs and abilities of people change as they advance from childhood to old age and the abilities of individuals in any particular age group vary substantially. It is important to recognize that functional and cognitive limitations vary from comparatively minor, such as mild hearing loss or use of spectacles only to read, to blindness, deafness or the inability to move part or all of one's body. It should be noted that although some limitations may be minor in nature, in combination, as is the case in ageing, these can pose a significant problem.

0.3 For many years, standards bodies at the national and international level have addressed the needs of persons with disabilities in the development of specific standards in the area of assistive technology and accessible building design. However, the needs of older persons and persons with disabilities are not being adequately addressed when other relevant standards for everyday products and services are written or revised. Standards bodies are starting to address ageing and disability issues and will, increasingly, develop and implement policies and programmes in their products and services to include the needs of older persons and persons with disabilities. It is important to ensure the representation of interests of older persons and persons with disabilities in the development of these solutions.

0.4 This Guide is intended to be part of the overall framework that standards bodies can use in their efforts to support the need for more accessible products and services. The ISO/IEC Policy Statement 2000 — *Addressing the Needs of Older Persons and People with Disabilities in Standardization Work* sets out the principles for ensuring that the needs of older persons and persons with disabilities[1)] are incorporated in the standards-making process, providing justification on humanitarian and economic grounds. This Guide supplements the ISO/IEC Policy Statement by identifying problem areas which need to be considered when drafting standards, recognizing the constraint that standards should normally not be design-restrictive. It is intended for those involved in the preparation and revision of International Standards but also contains information which may be useful for others such as manufacturers, designers, service providers and educators.

0.5 Of necessity, guidance provided in this Guide is general. Usability issues for people with impairments are identified without specific solutions. It is recognized that additional sector-related guides need to be developed for specific product or service sectors.

1) Developments in the field of accessibility have resulted in the creation and use of a wide variety of terms and definitions, related to older persons and disability, which differ throughout the world. For example, some people prefer to use the term "people with disabilities" and others prefer "disabled people". Overall, terms have evolved to become more precise and descriptive, rather than negative or stigmatizing. As no universal practice exists, the terms used in this Guide reflect the language generally used by international agencies such as the United Nations Organization and the World Health Organization.

Guidelines for incorporating accessibility in standards

1 Scope [NEEDS UPDATING/REVIEW]

1.1 This Guide provides guidance to writers of relevant International Standards on how to take into account the needs of older persons and persons with disabilities. Whilst recognizing that some people with very extensive and complex disabilities may have requirements beyond the level addressed in this Guide, a very large number of people have minor impairments which can be easily addressed by relatively small changes of approach in standards, thereby increasing the market for the product or service.

This Guide aims

a) to inform, increase understanding and raise awareness about how human abilities impact on the usability of products, services and environments,

b) to outline the relationship between the requirements in standards and the accessibility and usability of products and services, and

c) to raise awareness about the benefits of adopting accessible design principles in terms of a wider market.

1.2 This Guide applies to products, services and environments encountered in all aspects of daily life and intended for the consumer market and the workplace. For the purposes of this document, the term ‘products and services’ is used to reflect all these purposes.

1.3 This Guide

a) describes a process by which the needs of older persons and persons with disabilities may be considered in the development of standards,

b) provides tables to enable standards developers to relate the relevant clauses of a standard to the factors which should be considered to ensure that all abilities are addressed,

c) offers descriptions of body functions or human abilities and the practical implications of impairment,

d) offers a list of sources that standards developers can use to investigate more detailed and specific guidance materials.

1.4 This Guide provides general guidance. Consideration should be given to the development of additional guides for specific product or service sectors.

1.5 While it is recognized that accessibility and usability are important for both products amd services, international work on services standards is at the preliminary stage. At present, this Guide contains considerably more guidance on products than on services.

2 References [NEEDS UPDATING/REVIEW]

ISO/IEC Guide 37:1995, *Instructions for use of products of consumer interest*

ISO/IEC Guide 50:—[2], *Safety aspects — Guidelines for child safety*

ISO/IEC Guide 51:1999, *Safety aspects — Guidelines for their inclusion in standards*

ISO/IEC Policy Statement, 2000, *Addressing the needs of older persons and people with disabilities in standardization work*

World Health Organization, *International Classification of Functioning and Disability*, ICIDH-2 Beta-2

3 Terms and definitions [NEEDS UPDATING/REVIEW]

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

NOTE This clause is designed to provide clarification of some of the terms used in the fields of ergonomics, accessibility and standardization. It does not provide descriptions of body functions and impairments. This information is provided in clause 9. (See also Introduction, footnote 1, page v.)

3.1
systems
products, services, facilities, and/or built environments

3.2
diverse users
individuals with differing functional needs related to their use of a system

NOTE Functional needs can result from individuals differing in their sensory/perceptual, physical, and cognitive/intellectual characteristics and abilities. Functional needs vary over time and across contexts.

3.3
diverse contexts
differing environmental, economic, social, and cultural conditions

3.4
effectiveness
accuracy and completeness with which users achieve specified goals

3.5
efficiency
resources expended in relation to the accuracy and completeness with which users achieve goals

3.6
satisfaction
degree to which user needs are satisfied when a product or system is used in a specified context of use

3.7
freedom from risk
degree to which a product or system mitigates the potential risk to economic status, human life, health, or the environment

3.8
context coverage
degree to which a product or system can be used with effectiveness, efficiency, freedom from risk and satisfaction in both specified contexts of use and in contexts beyond those initially explicitly identified

2) To be published. (Revision of ISO/IEC Guide 50:1987.)

BELOW FOLLOW THE TERMINOLOGICAL ENTRIES FROM GUIDE 71:2001 UNCHANGED

3.4
ergonomics
human factors
that branch of science and technology that includes what is known and theorized about human behavioural and biological characteristics that can be validly applied to the specification, design, evaluation, operation and maintenance of products and systems, to enhance safety, and effective and satisfying use by individuals, groups and organizations

3.5
accessible design
design focussed on principles of extending standard design to people with some type of performance limitation to maximize the number of potential customers who can readily use a product, building or service which may be achieved by

— designing products, services and environments that are readily usable by most users without any modification,

— by making products or services adaptable to different users (adapting user interfaces), and

— by having standardized interfaces to be compatible with special products for persons with disabilities.

NOTE 1 Terms such as design for all, barrier-free design, inclusive design and transgenerational design are used similarly but in different contexts.

NOTE 2 Accessible design is a subset of universal design where products and environments are usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.

3.6
assistive technology
assistive device
piece of equipment, product system, hardware, software or service that is used to increase, maintain or improve functional capabilities of individuals with disabilities

NOTE This can be acquired commercially off-the-shelf, modified or customized. The term includes technical aids for persons with disabilities. Assistive devices do not eliminate an impairment but may lessen the difficulty an individual has in carrying out a task or activity in specific environments.

3.7
impairment
problem in body function or structure such as a significant deviation or loss which can be temporary due, for example, to injury, or permanent, slight or severe and can fluctuate over time, in particular, deterioration due to ageing

NOTE 1 Body function can be a physiological or psychological function of a body system; body structure refers to an anatomic part of the body such as organs, limbs and their components (as defined in ICIDH-2 of July 1999). See also footnote 1, page v.

NOTE 2 This definition differs from that in ISO 9999:2001 and, slightly, from ICIDH-2/ICF: May 2001, WHO.

3.8
activity limitation
difficulty an individual may have in executing taks or actions

3.9
user
person who interacts with the product, service or environment

NOTE Adapted from ISO 9241-11:1998.

3.10
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]

3.11
alternative format
different presentation which may make products and services accessible by the use of another mobility or sensory ability

3.12
working dog
guide dog, hearing and seizure, service (usually assisting with mobility needs) and social therapy dog, or any combination of these

4 Accessibility [NEW CLAUSE]

There is no single definition of “accessibility”. For this reason, frequently-used definitions are given in this clause to introduce the user to the meaning that has been applied this term.

4.1 “Accessibility” in the United Nations Convention

The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) was adopted in 2006. The purpose of the Convention is "to promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities, and to promote respect for their inherent dignity. Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others."

The Convention defines the objectives of “accessibility” as follows (see Article 9, clause 1):

“To enable persons with disabilities to live independently and participate fully in all aspects of life, to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas. These measures, which shall include the identification and elimination of obstacles and barriers to accessibility, shall apply to, inter alia:

(*a*) Buildings, roads, transportation and other indoor and outdoor facilities, including schools, housing, medical facilities and workplaces;

(*b*) Information, communications and other services, including electronic services and emergency services.”

4.2 “Accessibility” in standardization

In the context of standardization, different definitions for the term “accessibility” exist as well but in general, the term is used with an even wider scope than in the UN Convention. A widely-used definition refers to “the extent to which products, systems, services, environments and facilities can be used by persons from a population with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use” (reference: ISO 26800:2011, ISO/TR 9241-100:2010 and ISO/TR 22411:2008). The range of user characteristics and capabilities is generally considered to include those of older persons and persons with disabilities, but is not limited to users who have a permanent disability.

Another concept that is often used in conjunction with accessibility is “usability,” for which different definitions also exist. A common and widely-accepted definition of usability is the “extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (reference ISO 9241-11:1998 and ISO 26800:2011). Usability emphasizes that a system, product or service should be easy for someone to use, e.g. its use should be intuitive, efficient, and comfortable. Notably, the term “usability” is defined more narrowly than “accessibility” since it limits applicability to “specified users.”

The two terms overlap to some extent and some standards even define the term “accessibility” as “usability of a product, service, environment or facility by individuals with the widest range of capabilities” (reference ISO/IEC 24751-1, -2 and -3:2008, ISO/TR 9241-20 and -171:2008, ISO 9241-210:2009, ISO/IEC 25062:2006, ISO/IEC 24756:2009, ISO/IEC 26513:2009). This perspective emphasizes that accessibility involves both ease of use (which can affect use efficiency and use satisfaction) and success of use (i.e., effectiveness).

4.3 "Accessibility" in design

Many terms are used internationally to refer to the application of accessibility in the design of products, systems, services, environments and facilities to ensure they are accessible to and usable by the greatest diversity of users. Over the past few decades, the terminology has progressed from “barrier-free” design to “accessible” design to the terms currently used most commonly:

- Universal design
- Design for all
- Inclusive design

While small differences exist between the definitions and application of these terms, the general approach is the same: to address to the greatest possible extent the needs of all potential users. These concepts strive to avoid differentiating between persons with and without disabilities and include all persons as potential users within a diverse population. These concepts recognize that we all can benefit from accessible systems in various contexts throughout our lives.

While it is the intent of these concepts that "mainstream" systems be usable by as many persons as possible, this does not mean that all users are expected to use a system in the same manner. The goal is to optimize accessibility and usability for the largest number of users without individualization but also to provide compatibility to allow individualization when it better meets the needs or preferences of individuals.

NOTE Annex C contains more information on these design approaches.

Formatted: Bullets and Numbering

45 Increasing importance of accessibility [NEW CLAUSE]

A number of global trends have contributed to increasing the importance of accessibility.

5.1 Global trends supporting accessibility

5.1.1 Trends in models of disability

Significant changes have taken place in attitudes toward individuals with disabilities in the last decade, which has affected social policy thinking and approaches taken in standards development.

The earliest model of disability has been labelled the “medical model,” which described disabilities with reference to the medical conditions they were seen to arise from. This approach was encapsulated in the 1980 World Health Organisation’s (WHO) International classification of impairments, disabilities, and handicaps. (1) This was followed by the “social model” of disability, which stemmed from the publication of Fundamental Principles of Disability in 1976. (2). This revolutionised the understanding of disability by arguing that it was not mainly caused by impairments but by the way society was

organised and responded to disabled people. This model was accompanied by one called the “human rights model,” which has been utilized in international documents and instruments used by states as guidelines to enact legislation or to formulate policies concerning persons with disabilities. These documents typically expressed a moral and political commitment that states should take in regard to persons with disabilities.

Another set of models is labelled “functional models” of disability because they provide a foundation for development of specifications for design of various things such as learning and interaction with information and communication technologies...

NOTE Annex B contains more information about these models of disability.

5.1.2 Trends in global demographics

According to the World Report on Disability (published by the World Health Organization and the World Bank in June 2011), approximately 15% of the world population (over one billion people) has some type of temporary or permanent disability[1], and 80% of these individuals live in developing countries. These persons may be prevented or restricted from participating fully in society due to unnecessary impediments.

With an ageing population, the demand for accessible and usable products and services increases. Part of this population represents an important economic force, which results in a direct rise in the demand for accessible and usable products.

5.1.3 Trends in regulatory frameworks and governmental policies

The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) is the basic international framework addressing the rights of persons with disabilities.

The Convention had been signed in June 2012 by some 150 countries and ratified into national law by over 110 countries, making progress towards increasing the accessibility of public facilities and services a national obligation for the governments in these countries.

Partly in response to the UNCRPD, in many countries government procurement rules require that products and services meet certain accessibility requirements as a precondition to qualify to participate in public procurement. These government measures contribute to the growing size of the market for accessible products and services.

5.1.4 Trends in design: Accessible products are better products

The demand for accessible product features is increasing. Global markets composed of consumers/users from different countries, regions, cultures and races make it a necessity to consider users' varying capabilities, different knowledge bases and expectations in the design of products. As a consequence, the application of accessible design principles is becoming increasingly mainstream. The usability of products, services and environments as perceived and experienced by end-users is a key driver in product design and development.

Features that make products and services usable for persons with disabilities can also make them convenient and easy to use for everyone else. This is particularly helpful when people have temporary difficulties, such as lost glasses, a broken leg or a journey with a pram/stroller or bulky luggage. Increased accessibility and usability often result, therefore, in better products and services for all.

5.1.4 Trends in sustainable development: Accessibility supports sustainability

The attempts to re-orient development objectives towards sustainability and to achieve a balance between the three pillars of sustainable development -- the economic, social and environmental aspects -- recognize that social and other considerations have a higher priority than in approaches to

development that are driven exclusively by economic concerns. Accessibility is increasingly understood as an important and indispensable aspect of sustainability.

ISO 26000:2010, *Guidance on social responsibility*, defines seven core subjects, the seventh of which is “Respect for human rights.” It states, “An organization should respect human rights and recognize both their importance and their universality.” This approach provides substantial support for addressing the needs of diverse users as part of social responsibility and sustainability.

5.2 Implications for standards development

5.2.1 A primary goal of standards development should be to optimize accessibility and usability of products, systems, services, environments and facilities in order to provide equal opportunities for all people. People are diverse and different people should have the same rights and opportunities to participate in society.

5.2.2 No two people have exactly the same abilities. The differences in abilities among people can be influenced by both internal and external factors. The internal factors are specific to each person. The external factors are the particular characteristics of a specific activity and the environment in which the activity occurs which can affect the person's ability to participate in the activity. Standards developers should understand that barriers in the environment can contribute to people's functional impairments.

5.2.3 Features that make products and services more usable for persons with disabilities can also make them also more convenient and easier to use for everyone else. As mentioned under 5.1.3, this is particularly helpful when people have temporary difficulties or when environmental conditions are unfavourable, such as dim lighting, loud background noise, or busy activity among people nearby. A well-designed wheelchair ramp built adjacent to or taking the place of a set of stairs could be very useful for a person pushing a pram/stroller. A device with a large switch could make use easier for someone with an injured hand or arthritis. A sensor which stops doors from closing can prevent accidents when used by a person who has a back injury which impairs movement, or by a wheelchair user, a young child or a parent with a pram/stroller.

5.2.4 Addressing users’ functional needs earlier rather than later in the design process enables producers, at little or no extra cost[2], to design and produce products, services and environments that more people can use more easily and fully. Standardization can greatly influence the design of products and services and can therefore contribute significantly to reducing existing and minimizing the introduction of new barriers.

5.2.5 It is important that mainstream products be designed to be compatible with the types of assistive technologies often used by older persons and persons with disabilities. Assistive technology, in the form of equipment, software and services, is available to meet a variety of needs of older persons and persons with disabilities.

Footnotes:

1 World Health Organization and World Bank (June 2011), *World Report on Disability*, pp. 29-31 and Summary of the report, p.8

2 It is estimated that ensuring full compliance with accessibility standards in new buildings adds generally only 1% of extra-costs, which is much cheaper than adapting existing buildings later on, see *World Report on Disability*, p. 173.

6 Accessibility Principles [NEW CLAUSE]

6.1 General use of principles

Accessibility principles provide a high level foundation for this guide. These accessibility principles can also be used to help identify more specific accessibility requirements and recommendations to be included within international standards and technical reports. They can also be applied to the evaluation and design of systems. It is important to have representation of diverse users throughout the evaluation and design of these systems.

It is not the intent of this guide that these accessibility principles be used as an alternative to more specific accessibility requirements and recommendations. Rather, these principles are presented to aid standards developers in the identification of a comprehensive range of specific accessibility requirements and recommendations.

The accessibility principles are not strictly independent and can semantically overlap. It might be necessary to achieve a “trade-off” between principles in order to optimize accessibility for diverse users in diverse contexts. The relevance and relative importance of each principle is determined by the particular circumstances.

Accessibility principles can be organized into groups that emphasize their main focus of application.

- User-focused principles emphasize the individual users who have accessibility needs. User-focused accessibility principles include:
  - Suitability for the Widest Range of Users
  - Conformity with User Expectations
  - Suitability for Individualization
- Interaction-focused principles emphasize the individual interactions (including the sharing of information content and functionality) between users and systems. Interaction-focused accessibility principles include:
  - Approachability
  - Perceivability
  - Understandability
  - Controllability
- Task-focused principles emphasize the ability for interactions to achieve intended accomplishments. Task-focused accessibility principles include:
  - Usability
  - Error Tolerance
- Solution-focused principles emphasize technical issues which could impact upon achieving accessibility. Solution-focused accessibility principles include:
  - Equitable Use
  - Compatibility

NOTE There are no environment-focused principles because of the wide variation in possible environments and the lack of control over many of these environments. Where facilities and/or built environments are the objects with which the user is interacting, they are considered to be part of the system.

6.2 User-focused principles

6.2.1 User-focused Principle 1: Suitability for the widest range of users

A system is suitable for the widest range of users if it meets the needs of diverse users in diverse contexts.

6.2.2 User-focused Principle 2: Conformity with user expectations

A system conforms to user expectations if it is predictable based on the user's experience, the context of use and/or on commonly accepted conventions.

NOTE 1 User expectations are based upon an individual's past experience. This principle is not intended to preclude new systems but rather to encourage that the manner of operation of systems be predictable. New systems might necessitate some degree of learning to re-establish user expectations.

6.2.3 User-focused Principle 3: Individualizable

A system is individualizable if its operations, interactions, content, and/or components can be configured to meet the needs of individual users.

NOTE 1 This principle recognizes that a single solution is seldom optimal in meeting the needs of every user and context of use.

6.3 Interaction-focused principles

6.3.1 Interaction-focused Principle 1: Approachability

A system is approachable if diverse users can access it to accomplish the task.

NOTE 1 This principle recognizes that the sizes, designs and layouts of control mechanisms, processes, access routes, and spaces are important for diverse users in diverse contexts.

NOTE 2 The system could be approachable directly (e.g. by touch, voice), via remote means, or through technical aids (e.g. assistive technology).

NOTE 3 This principle recognizes the importance of taking into account those barriers that can be reasonably identified and controlled. It also recognizes that there might be additional unidentified barriers within certain environments.

6.3.2 Interaction-focused Principle 2: Perceivability

A system is perceivable if diverse users can sense the information and functionalities it presents in diverse contexts.

NOTE 1 This principle recognizes that making use of multiple modalities (e.g. visual, auditory, tactile, olfactory) can provide perceivability for more diverse users in diverse contexts.

NOTE 2 The use of a single sensory modality can exclude some users in some contexts from perceiving information and functionalities.

6.3.3 Interaction-focused Principle 3: Understandability

A system is understandable if its information and functionalities are clear to diverse users.

NOTE 1 This principle is about correctly interpreting the meaning of what has been perceived.

NOTE 2 This principle recognizes that it is important for a system to minimize the need and effort required for users to learn and to remember.

6.3.4 Interaction-focused Principle 4: Controllability

A solution is controllable if the user is able to initiate and complete the interaction(s) required to accomplish the task.

NOTE 1 This principle depends on the ability of users to use different control mechanisms (e.g. by touch, gesture, voice) to interact with the system. Providing multiple formats of operation can improve controllability.

6.4 Task-focused principles

6.4.1 Task-focused Principle 1: Usability

A system is usable if it supports the user in the completion of the task with effectiveness, efficiency, and satisfaction.

NOTE 1 Effectiveness involves the accuracy, completeness, and appropriateness of the user's interactions with the system.

NOTE 2 Efficiency involves the time and other resources required to use the system.

NOTE 3 Satisfaction involves concepts such as usefulness, trust, pleasure, and comfort.

NOTE 4 Effectiveness, efficiency and satisfaction can vary greatly depending on the specific user and context of use.

6.4.2 Task-focused Principle 2: Error tolerance

A system has error-tolerance if despite predictable errors, the intended task can be achieved with either no, or minimal, corrective action by diverse users.

NOTE 1 This principle recognizes that error tolerance might avoid a number of problems (e.g. impairing the accomplishment of the task, personal injuries, damage to the system).

6.5 System-focused principles

6.5.1 System-focused Principle 1: Equitable Use

A system provides equitable use if it allows diverse users to accomplish tasks in an identical manner whenever possible; or in an equivalent manner when an identical manner is not possible.

6.5.2 System-focused Principle 2: Compatibility

A system provides compatibility if it allows diverse users to use other systems to interact with it to accomplish the task.

NOTE 1 This principle recognizes that while it is not feasible to make all systems directly accessible to all people, the provision of compatibility can make it possible for diverse users to use technical aids (e.g. Assistive Technologies) to utilize the system.

NOTE 2 In the IT domain compatibility is often referred to as interoperability.

~~5~~7 Using Guide 71 [NEEDS UPDATING or DELETION]

Formatted: Bullets and Numbering

~~6~~8 Developing standards — Issues to consider in suppport of accessibility in the standards development process [UPDATED CLAUSE]

Formatted: Bullets and Numbering

Clause 8.1 addresses aspects which should be considered by standards organizations with regard to improving the overall conditions in terms of awareness and process support for accessibility. Clause 8.2 gives guidance on how committees can support accessibility in standards development and clause 8.3 gives detailed advice on how Guide 71 could be used at the various development stages, by which users and with which purpose and objectives.

8.1 Considerations by standards organizations

When developing standards related to accessibility issues, standards organizations should ensure appropriate representation by individuals or bodies representing persons with disabilities. Standards organizations should also take care to train their staff as well as committee officers (committee secretaries and chairpersons or convenors of working groups) to raise awareness about the importance of accessibility and enable them to alert their committees to aspects in standards projects where accessibility may be addressed.

Standards organizations may consider introducing tools or systems in certain stages of the regular standards development process (e.g. as part of votes on new projects or submission of draft standards for vote) that would assist in identifying whether or not standards projects comprise aspects of accessibility. These tools could range from items in simple check lists on voting forms to more elaborate electronic solutions. Early identification of such aspects could ensure that accessibility concerns are adequately addressed during the development process, consistency between different standards that address accessibility issues would increase and communication and exchange between different groups involved in the development of such standards would be facilitated.

As a horizontal issue covering many subject areas, support for accessibility by standards bodies could extend to providing specialized support and contacts on accessibility issues by a dedicated staff person used as a resource for all committees on this issue.

8.2 Considerations by standards committees

Committees may find the following process helpful in ensuring that accessibility issues are addressed and included, when drafting a new standard or at each revision of an existing one. The process reads from left to right with guidance on achieving each objective in the columns below.

Define standards project	Ensure committee well equipped	Develop content of Standard	Review process	Publish Standard
Identify: • purpose of standard • end-users of product or service being standardized • current accessibility of product or service to broad range of users sources: • suppliers • groups representing older persons and persons with disabilities • user surveys • consumer test panels • guides and policies	**Ensure:** • committee members aware of accessibility issues, ageing and disability, experts and users represented and/or training provided • meeting rooms accessible to older persons and persons with disabilities • committee papers available in alternative formats • data available on user issues, e.g. injury data, focus group research	**Use Guide 71 and other guidance material to help determine:** • particular needs and safety concerns of older persons and persons with disabilities • ways of minimizing hazards through new or enhanced requirements • ways of maximizing accessibility of product or service to broad range of users • where alternative solutions, such as assistive technology, are necessary	**Ensure:** • usability requirements in standard have been assessed, e.g. by consumer test panels • language and terminology of standard is acceptable to older persons and persons with disabilities (should not discriminate) • draft is circulated to wide range of stakeholders, including groups representing older persons and persons with disabilities	**Ensure:** • that formats and formatting options are selected that are easily supported by screen readers • that standard can be reproduced in alternative formats

8.3 Application in the standards development process

8.3.1 The following table provides a more detailed overview of the standards development process using the process stages in ISO and IEC as examples. However, this process could be adapted to similar processes operated by regional or national standards bodies or other standards development organizations so as to ensure the information in this clause remains useful also in other environments and for other organizations. The purpose of the table is to indicate at which stages, by which users, in which form and with which objectives Guide 71 should be applied for projects which address or are intended to address aspects of accessibility.

Standards develop-ment stage	**Document design-nation**	**Purpose of use of Guide 71 at this stage**	**Users of Guide 71 at this stage**	**Form of reference to Guide 71 at this stage**	**Objectives of the use of Guide 71 at this stage**
Proposal stage	New Work Item Proposal (**NP**)	Identify whether accessibilit y as a topic is addressed	a) Proposer of new project b) Committee secretary c) Office of the CEO: If the	NP voting form/Electronic voting application (e.g. in the form of a check list)	a) If accessibility is addressed, proposer should indicate that Guide 71 has been consulted b) Committee

		in the proposal for a new project in which case Guide 71 should be applied. If project is approved, the office of the CEO should register this information	project is approved, register that it contains content related to accessibility		secretary should verify that Guide 71 has been consulted c) Office of the CEO: Register that the approved project contains content related to accessibility
Preparatory stage	Working Draft (**WD**)	Guide 71 should be applied in the elaboration of the design, structure, and architecture of the new standard	a) Convenor/ Project leader b) Experts	Refer to Guide 71 and related documents for guidance	Project leader to indicate that Guide 71 has been applied by completion of a short questionnaire
Committee stage	Committee Draft (**CD**)	Guide 71 should be applied to verify that accessibility content has been appropriately dealt with	a) Committee chair b) Committee secretary c) Committee members	Check whether Guide 71 and related documents have been applied	Committee secretary to indicate that Guide 71 has been applied
Enquiry stage	Draft International Standard (**DIS**)		a) Programme Managers/Editors in the office of the CEO b) Interested member bodies	Check whether Guide 71 has been applied	Programme Managers/Editors in the office of the CEO to indicate that Guide 71 has been applied
Approval stage	Final Draft International Standard (**FDIS**)	Guide 71 should be applied to ensure that accessibility contents is	Interested member bodies		

		adequately addressed in line with ISO/IEC's core document for this purpose			
Publication stage	International Standard (**IS**)	Ensure publication formats and options are accessible	Publishing department of the office of the CEO	Publishing policy and internal publishing rules	
Review stage	International Standard (under review)		Relevance of the IS for accessibility to be identified; member bodies voting during the review stage to verify whether Guide 71 had been satisfactorily applied		

9 Alternative formats for interaction

9.1 General considerations

An alternative format (defined in 3.8) describes a different presentation or representation intended to make products and services accessible through a different modality or sensory ability. By providing all input and all output, i.e. information and functions, in at least one alternative format, for instance visual and tactile, more people, including some with language/literacy problems, may be helped. In terms of function for people with dexterity and strength impairment, alternative packaging solutions may need to be envisaged. [8.2.1]

9.1.1 Presenting information via different senses

In this approach, the same information is provided through more than one sense, such as providing visual and auditory information for the same content. [new TR 22411, 8.1.1.1]

9.1.2 Presenting information via different aspects of the same sense

In this approach, additional cues are provided, such as showing two different visual implementations of the same content. [new TR 22411, 8.1.1.2]

9.1.3 Physical operation controls by alternative means

People with physical impairments due to injuries, diseases (e.g., amyotrophic lateral sclerosis (ALS)), or musculoskeletal disorders such as arthritis or repetitive strain injuries, may have difficulty operating physical controls of systems, products, and services. For these individuals, other means of controlling functions of interacting with a product, service or system should be provided. Common alternatives include automatic speech recognition and eye gaze input, which, for example, can substitute for keyboard or mouse input. [new TR 22411, 8.1.1.3]

9.2 Alternatives to visual information

The type and texture of surface finishes can be important in providing tactile feedback which can reinforce instructions and warnings for those with visual impairment. Where the principal form of instruction on a product or in a building is written, alternatives would be voice (instructions 'spoken' by a product or service), sound (feedback from clicks, bells and buzzers) or touch (tactile marking or grip).

Wherever feasible, visual information which is presented on electronic products should be available from the product in audio or other sensory stimuli for those with a visual impairment including those who cannot read braille, as well as for those who have difficulty with reading or are unable to read.. [8.2.2]

9.2.1 Tactile markings

Tactile markings can be used as an alternative to visual information not only for persons with visual impairments but also for persons whose eyes are occupied with other tasks. In principle, tactile markings can be used anywhere visual information is needed. However, some persons with touch impairments (e.g. older persons or persons with diabetes) have difficulty sensing tactile information. Surface temperature is unsuitable for conveying precise information. Tactile markings are useful for indicating locations, recognizing surface structure, perceiving shape of goods, and presenting information contained in characters, signs or plans.

9.2.2 Auditory signals

Auditory signals can be used effectively as an alternative to visual information. They are especially useful for delivering information to visually impaired persons. Auditory signals have the advantage that information can be conveyed to persons who cannot see or whose eyes are already occupied with other tasks such that they cannot attend to a visual display.

Auditory signals used in human-machine interfaces are simple and easy to install, but are sometimes abstract in their meaning compared to spoken instructions. When two or more auditory signals are employed in a product and service or when two or more products and services with an auditory signal are used at the same time and at the same place, those signals are required to be clearly discriminable from each other. Temporal patterns are one of the most robust cues with which the listener discriminates different auditory signals.

9.3 Alternatives to auditory information presentation

Wherever feasible, sound signals should be supported by visual or other sensory stimuli for those with a hearing impairment (e.g. communication in writing, graphical symbols, vibration or sign language). In particular, audible warnings, such as fire alarms, should also activate, for example, visual stimuli, such as flashing lights which are well sited and clearly indicated. [8.2.3]

9.3.1 Visual information

Visual information is one possible alternative to auditory information. Temporal changes of brightness or colour, such as flashing lights, step-changed lights, blinking lights, and flickering lights, can also be used, like auditory signals, to indicate the state of controls such as start, termination and emergency.

9.3.2 Tactile information

Tactile information is also a useful alternative to auditory information, particularly when vibratory, as in alarm clocks.

9.4 Alternatives to visually displayed text or graphic information [Other types (?) of alternative formats to information presentation]

9.4.1 General

Alternative information is “equivalent” to the original information when both fulfil essentially the same function or purpose. Thus, the equivalent fulfils essentially the same function for a person with a disability (at least insofar as is feasible, given the nature of the disability and the state of technology), as the primary information does for a person without any disability.

9.4.2 Alternatives to textual information visually displayed

Alternative information is “equivalent” to the original information when both fulfil essentially the same function or purpose. Thus, the equivalent fulfils essentially the same function for a person with a disability (at least insofar as is feasible, given the nature of the disability and the state of technology), as the primary information does for a person without any disability.

9.4.3 Alternatives to graphical information

The following accessibility considerations are relevant to the use of graphical information:

- provision of textual or pre-recorded audio information as alternatives to graphical information can help persons with visual impairments or blind persons to understand the graphical information;
- text or pre-recorded audio that substitutes graphical information can have information that is equivalent to the information conveyed by the corresponding graphic.
- *Presenting information via different aspects of same sense*

9.5 Alternative modes of operation

9.5.1 Alternatives to voice input

Where voice input is used to activate a process, for example building entry security systems, alternatives such as keypads or the use of video monitoring should be considered. [8.2.4]

9.5.2 Alternatives to biological identification

Where biometric forms of identification are intended, an alternative form of identification or activation should also be provided. For example, if systems require a retinal scan and a person does not have a retina, or the system requires a fingerprint amd the person does not have hands or uses a prosthesis, such people are unable to operate the devices unless some alternative form of identification is substituted. [8.2.5]

10 Considerations to facilitate accessibility

10.1 Considerations related to human abilities and characteristics

10.1.1 General considerations

The physical, organisational, social and legal environments in which a system, product, service or facility is intended to be used shall be identified and described, and the range defined. (ISO 26800, 4.2 “Environmental context”)

10.1.2 Sensory considerations

10.1.2.1 Seeing consideration [Vision]

Persons with no useful vision and blindness depend mainly on tactile and acoustic input. The majority of people with difficulties seeing have some vision, and therefore use visual stimuli such as size, luminance and colour contrast. Typically, the simpler an image and the clearer its definition, the easier it is to see and read. [9.2.1.3]

Design in relation to visual impairment should take into consideration factors that increase risk such as

- sharp points and edges on products being handled, particularly if the user relies on touch to identify features,
- physically unstable items that might fall out of reach,
- changes in surface level, obstacles or protrusions which may result in slip, trip, collision and fall hazards, or cause injuries,
- open fire and flames,
- hot surfaces that might be touched inadvertently,
- corrosive substances unless they are labelled with a universally recognized tactile warning,
- evacuation procedures which rely solely on visual indicators,
- visual warnings which rely solely on colour or on colours with poor contrast between text and background. [9.2.1.4]

10.1.2.1.1 Choice of colour and coding

This is important for ease of recognition and ease of seeing. Some colour combinations are also more effective. For example some colours, such as red/green, are not distinguishable by a significant minority of the population (those with colour blindness). [8.5.1]

All information conveyed with colour should also be available without the perception of colour. Colour coding should not be used as the only means for conveying information, indicating a response or distinguishing a visual element. [8.5.3]

10.1.2.1.2 Colour combination

The best colour combinations depend on the purpose of information, whether it is for guidance or a hazard warning, and the lighting conditions under which it is most likely to be viewed. For example, black on yellow or light grey are general purpose combinations which provide strong definition without too much glare, pastel shades on pastel backgrounds or red lettering or symbols on light grey are difficult to see and should normally be avoided. [8.5.2]

10.1.2.1.3 Luminance contrast

Contrast of luminance is one of the most critical factors for visibility. The higher the contrast, the better the visibility. The sensitivity to contrast for fine images decreases with age due to optical scattering in the eye. The contrast sensitivity is much lower for persons with low vision due to various types of visual impairments.

10.1.2.1.4 Font design, general

The required size of font for information, warnings and labelling of controls, relates to the probable viewing distance, level of illumination and colour contrast of the text against its background. The choice of font, whether with or without serif, in upright form or italics and light, medium or bold appearance also has a significant impact on legibility. Standards developers should also be aware that text written in CAPITAL letters is more difficult to read. This is significant for those with a visual impairment. Consideration should be given to specifying size and style of font and symbols for warnings. [8.6]

With increasing age, the lens in the eye loses elasticity and the ability to focus clearly. The legibility of font and symbols is associated with the reader's ability to visually discriminate one character from another, and is affected by the physical construction and properties of the font or symbol. Legibility is different from readability, which addresses the meaningful grouping of alphanumeric characters to form words or sentences. Readability is affected by grammar, writing style, or even the spacing between characters or sentences.

10.1.2.1.5 Font size

A reader's visual acuity is one of the critical parameters that affect the legibility of letters or symbols. The better the visual acuity he or she has, the smaller the legible font size he/she can see. Viewing contexts affect visual acuity. Visual acuity is a function of luminance and viewing distance. The acuity becomes worse as the luminance decreases. The acuity in near viewing distance (less than about 1 m) becomes worse with ageing.

10.1.2.1.6 Font style

Font style is also a factor affecting legibility.

10.1.2.1.7 Position of visual information

The position of information and controls on a product, or in a building, or even the point at which information is available for a service (e.g. warnings about the terms on which dry-cleaners accept clothes for processing) are important. They need to be prominent for someone with a visual impairment or language/literacy disability, visible from the angle of view of someone standing and seated in a wheelchair, and easily accessed by seated or standing users without bending and stretching. This may mean that the positioning needs to be flexible or adjustable or duplicated. Information or controls should be located in a position where they will not be obstructed, for example when a product is held by either or both hands, or held in a different way by someone with manipulation or strength impairment. [8.3.1]

Factors to consider include logical grouping of information and controls, line length of text, relevance of information and relationship of controls to actions to be undertaken. [8.3.3]

10.1.2.1.8 Position of information

Detectability of visual information largely depends on its positioning when placed in the periphery of the sight of a person. The detectability depends on the size of the useful field of view, which in turn depends on the viewing condition.

The general shape of the useful visual field is an ellipsoid with the horizontal axis longer than the vertical. The effective range for presenting visual signs is larger in the horizontal direction than in the vertical. The size of the useful field of view becomes larger when the target size is larger, the contrast becomes higher and the colour difference between the target and the background becomes larger also.

10.1.2.1.9 Location of controls

Controls are placed such that they can be operated easily by someone standing or seated in a wheelchair, without bending and stretching. The reach envelope of humans is affected by the length and the range of motion (RoM) of upper limbs of the human body. In general, RoM decreases with age, and the reach envelope also becomes smaller.

10.1.2.1.10 Provision of lighting

Appropriate lighting ensures that those with a visual impairment are better able to see instructions and controls. This should also be considered for those with a hearing impairment to assist with lip reading or sign language communication. [8.4.1]

10.1.2.1.11 Ambient lighting

The likely lighting levels in typical use should be considered, for example television controls may be operated in a darkened room, installation of a product may be in a dark space. [8.4.2]

10.1.2.1.12 Avoidance of glare

Too high light levels and strong directional light can result in deep shadows or glare. Reflecting surfaces on information panels and glossy paper in instruction books or on packaging containing warnings should be avoided, to reduce the possibility of glare. [8.4.4]

10.1.2.1.13 Printed information

Printed visual information should be available in alternative formats (electric audio, large raised letters or braille, etc.) which are readable by individuals without vision. [8.2.2]

10.1.2.1.14 Avoidance of photosensitive seizures

Flicker rates, or flashing or blinking text, objects or video screens should avoid frequencies that are most likely to trigger visually induced seizures. [8.2.6]

10.1.2.1.15 Special considerations for low vision

Printed visual information should be available in large print for those with low vision. [8.2.2]

Contrast sensitivity is much lower for persons with low vision due to various types of visual impairments.

Persons with low vision tend to prefer light text on a darker background rather than darker text on a light background.

10.1.2.2 Hearing consideration [Hearing and Speech]

With or without a hearing aid, the level, frequency and clarity of any sound is important. Prelingually deaf people may have difficulty understanding written and spoken language. [9.2.2.2]

People with a hearing loss are at an increased risk if spoken announcements and warnings are not loud or intelligible enough for them, or if frequencies are too high to detect. [9.2.2.4]

Even with a good accoustic environment, hearing-impaired people have difficulty in hearing at a distance from the source of the sound. The availability of communication systems such as induction loops, infrared and radio systems means that they should be included. [8.20.3]

10.1.2.2.1 Sound pressure level and frequency of auditory signals

People with a hearing loss are at increased risk or are disadvantaged if warnings are not loud enough, or if the pitch is too high or too low. Where possible, volume should be adjustable over a wide range. Information should also be presented in multiple frequencies where possible (e.g. an alarm signal could consist of a strong component at multiple frequencies). Sudden changes in volume should also be avoided. [8.9]

10.1.2.2.2 Voice output

Rules for spoken information are similar to those for printed information. The context should always be given to ensure that information is meaningful and instructions should be provided in a logical order. Key points should be reinforced by repetition. People with hearing loss are at an increased risk or disadvantage if spoken announcements are not loud enough, or if the pitch is too high or too low. [8.7.4]

10.1.2.2.3 Sound level of spoken information

The sound level of announcements, or voice instructions, has a large influence on the comprehension of spoken information. Announcements are required to be comfortably loud for listeners; announcements that are too soft or too loud may not be fully understood. Spoken announcements sound comfortably loud when the listener can recognize them nearly 100 % without any special effort.

The comfortable sound level for announcements depends on the environment in which they are presented. In quiet environments, the absolute level of announcements is a key factor. Persons with age-related hearing loss prefer louder speech. However, the amount of increment required is not very large: a few decibels on average.

In noisy environments, the difference between the level of an announcement and that of the background noise determines the intelligibility of the announcement. When the noise level is low, the effect of noise is usually negligible. When the noise level is high, a constant signal-to-noise ratio is required to attain comfortable listening. Control systems that adjust sound level automatically are available to keep a certain signal-to-noise ratio, and are sometimes used for spoken announcements in public spaces as well as for acoustic traffic signals. When the noise level is even higher, people tend to have difficulty in speech communication. Provision of necessary information in an alternative form of instruction can increase accessibility.

10.1.2.2.4 Frequency range of spoken information

10.1.2.2.5 Speaking rate

The speaking rate is defined as the number of speech items uttered in a unit time period. The rate is expressed, for example, as the number of words per minute or the number of syllables per second. A normal rate is, for example, 140 to 170 words/min in English or 8 to 9 mora/s in Japanese.

10.1.2.2.6 Repeating presentation

10.1.2.2.7 Voice input (move it to another section?)

10.1.2.2.8 Cognitive aspects of voice instruction [new from N062]

Voice instructions are widely used, not only as an alternative format for visually impaired people but also for general information for all people in private as well as public spaces.

Cognitive aspects of auditory processing decline with age. Older people have more difficulty than younger ones in ignoring irrelevant information from one source when processing relevant information from another. They also require more time to switch their processing from one source of auditory input to another. Older people also have greater difficulty in perceiving auditory information via synthetic speech. They also learn new tasks and respond to instructions more slowly. For some persons who have faster processing ability, a slower speed of voice instruction does not necessarily improve their performance. If a task requires that older people simultaneously process or manipulate information, as well as remember it, performance also declines.

Many of the cognitive deficits that accompany increasing age are also seen in younger persons with cognitive disabilities.

10.1.2.2.9 Voice warnings or alerts [new from N062]

Voice warnings and alerts differ somewhat from general voice instructions, in that attracting the attention of the user is a priority. Data suggest that female voices have a greater attention-getting ability than male voices. However, recommendations concerning the use of male vs. female voices are sometimes culture-dependent; for example, male voices are used in fire-alarm systems in Japan.

10.1.2.2.10 Speech communication in noisy environment [new from N062]

A spoken announcement is understandable when the signal-to-noise ratio is above a certain level. It is comfortably audible for listeners when the signal-to-noise ratio is above a certain threshold (higher than that required for complete understanding).

10.1.2.3 Touch consideration [Tactile and haptic abilities]

Persons with impairments will often rely on other stimuli, particularly visual and auditory for information. People with artificial hands or who lack touch sensation may not be able to use tactile screens or similar types of control devices. [9.2.3.3]

People with hypersensitive touch will be hurt by stimuli which might cause only discomfort to other people — for example, by sharp points and edges, and very hot/cold surfaces. These stimuli are also more likely to harm people with limited sensitivity, who might remain in contact with them for too long. [9.2.3.4]

10.1.2.3.1 Spatial design of tactile markings

10.1.2.3.2 Temporal design of tactile markings

10.1.2.3.3 Spacing of tactile markings

10.1.2.3.4 Surface temperature

10.1.2.3.5 Appropriate range of surface temperature of objects

Surfaces which may be touched (even inadvertently) during normal operation should not become excessively hot or cold. Under hot and cold conditions the use of appropriate insulating materials should be taken into consideration.

A temperature-controllable surface can be kept within an appropriate temperature range to prevent skin burn damage and discomfort. Special attention is required for persons with impaired peripheral nerve function or thermoregulation, who are less sensitive to heat or cold or who take vasodilator medicine.

10.1.2.3.6 Ambient air temperature

Warnings that temperatures may be excessively high or low for functional reasons are of particular benefit to those with limited sensitivity. The format of the warnings should be accessible to people with visual or cognitive impairment. [8.15]

Special consideration for the appropriate thermal environment is necessary for persons whose thermoregulation and peripheral nerves are impaired, or who take vasodilator medicine.

10.1.2.4 Taste consideration/Smell consideration [Olfactory and gustatory abilities]

Impairment of the sense of taste or smell reduces the body's defence against toxic materials. For example, people may not be able to detect when food has deteriorated or be alerted to hazards such as smoke. [9.2.4.3] Information such as date of production and 'best before date provided clearly in labelling' for foodstuffs and alternative output to alert for hazards such as smoke can be helpful for persons with impaired taste and smell functions.

10.1.2.5 Vestibular Balance consideration [Proprioceptive abilities (new)]

Slips, trips or other unexpected disturbances to balance require rapid responses in joint rotations and limb movements and can place extraordinary demands on the balance control system. Even very small edges and protrusions can cause tripping. Balance impairment can lead to an increased fear of falling. People in wheelchairs, powered scooters and walkers may have balance impairments, and injuries can severely affect their independence.

10.1.3 Physical size, strength and movement considerations

Persons with movement-related impairments involving the upper limbs may have difficulties with complex operations, such as pushing and turning objects, which require sustained pressure and twisting of the wrist, which may be painful or impossible. These have implications for the size, shape and location of controls. They may have problems with tasks that require precision, such as opening packaging and dealing with fastenings. They may endanger themselves, for example by inadvertently activating controls, or failing to withdraw a hand quickly from a hazard, such as a flame. Individuals with impaired manipulation may risk injury through inadvertently dislodging a device during use. Product design needs to minimize hazards and consequences of limitations and unintended actions.

Persons with movement-related impairments involving the lower limbs may have difficulties transferring from one area to another and have an increased risk of tripping and for falls. They are particularly at risk during emergency evacuation of vehicles or buildings. The design of the built environment should minimize hazards .such as changes in surface level, obstacles or protrusions which may result in slip, trip, collision and fall hazards, or cause injuries and the consequences of falls.

Some Persons with movement-related impairments use equipment such as orthoses, aids for personal care, or mobility aids; others may require personal help. The design of the built environment should take into consideration the use of such equipment such as changes in surface level, obstacles, protrusions and extra space to allow for approach and maneuvering.

10.1.3.1 Design considerations associated with human size

Design standards for accessibility should consider the worldwide *geographic variability* (*body size statistical extremes* refer to ISO/TR 7250-2:2010) as an important *physical characteristic* of people related to their interactions with the environment.

Standards developers should consider the general design criteria for accessibility depicted by the four design guidelines (a – d) under *Accessible* (Universal) Design Principle 7.

(*ISO/TR 22411:2008, Annex A, Principles of Accessible Design*).

Principle 7: Size and space for approach and use

Appropriate *size and space* is provided for approach, *reach, manipulation*, and use regardless of user's body size, posture, or mobility.

10.1.3.1.1 Principle 7, Guideline "a"

Provide a *clear line of sight* to important elements for any seated or standing user.

10.1.3.1.2 Principle 7, Guideline "b"

Make *reach* to all components comfortable for any seated or standing user. (ICF Reaching b4452)

10.1.3.1.3 Principle 7, Guideline 'c'

Accommodate variations in *hand and grip size*. (ICF Structure of hand s7302)

10.1.3.1.4 Principle 7, Guideline 'd'

Provide *adequate space* for the use of *assistive devices* or *personal assistance*.
(ICF Design Construction and building products and technology for public use ranges from e150 to e155)

10.1.3.2 Movement-related structures

10.1.3.2.1 Strength [Muscle power considerations (b730)] and endurance (b740)

10.1.3.2.2 Voluntary movement (b760) and involuntary movement (Tone) (b740)

10.1.3.2.3 Balance (b755)

10.1.3.2.4 Lower body structure (s750) and upper body structure (s730)

Reach range (reach envelope)

Most people, whether standing or sitting and regardless of their ability to move the upper body and arms, can reach a height of 850 mm. The ability of wheelchair users to move their upper body varies widely, resulting in a large range for reach.

10.1.3.2.5 Fine hand use activity (d440) and gross motor consideration

Ease of handling

These characteristics of a product will affect how easy it is to lift, hold and carry. Lifting and carrying is eased if articles are shaped to facilitate easy grasping, with either or both hands. Light, compact articles are generally preferable thus the density of manufacturing materials needs consideration. Provided safety is not compromised wherever possible, products should be capable of operation by only one hand, preferably either hand. [8.12.1]

10.1.3.3 Voice and speech considerations (e?? b310)

The principal consequence of speech impairment is the barrier to communication and social interaction. Alternative forms of communication, such as sign language, or devices such as speech amplification, speech synthesis, or use of facsimile or keyboards, may assist. [9.3.5.2]

10.1.4 Mental considerations [Cognitive abilities]

Design in relation to mental impairment should take into consideration factors that increase risk such as

- decreased perception, which include difficulty taking in, attending to, and discriminating sensory information
- difficulties in problem-solving which include recognizing the problem, identifying, choosing and implementing solutions, and evaluating the outcome
- language impairment if a person is unable to comprehend written warnings or significant instructions
- memory impairment if an uncompleted task results in a dangerous situation such as the gas supply turned on but not ignited.

Design should ensure that risks and hazards that arise from impairment of mental functions are taken into consideration so that systems are safe.

10.1.4.1 Information available as text

Information should be made available in text format wherever possible, in addition to other forms, to facilitate recognition and translation into speech and other languages for those who have trouble seeing, recognizing or deciphering non-text information presentations. [8.7.1]

10.1.4.2 Complexity of information

Instructions or operations which are too complex will often deter older persons and persons with limited intellect from using a product or device. Simple written or spoken messages are also clearer to understand by someone with a visual or hearing impairment. [8.7.2]

10.1.4.3 Language support

Where instructions are to be provided in more than one language, written information in each language should be presented in separate sections of a manual rather than interleaved on a page; spoken information should be preceded by a clear statement in the language to be used. [8.7.5]

10.1.4.4 Graphical symbols and illustrations

The use of meaningful graphical symbols or illustrations, in addition to text, should be considered in instructions and also on a product, for ease of assembly or use. For example the same symbol should be used on the respective ends of parts to be joined, when assembling a product, or in the labels on controls. [8.8]

10.1.4.5 Other design considerations concerning cognitive abilities

Where there is a decrease in cognitive abilities, the following accessibility considerations are relevant;

- Products and services can be designed to be suitable for the task and to support users in dealing with planned interactions. The cognitive limitations of older persons in processing information can be considered.
- Procedures that it is reasonable to automate can be carried out by the product itself.
- Default values can be offered to the user so that he or she does not have to set them. However, it is possible to change default values.
- Unnecessary steps in a procedure can be omitted.
- In general, steps in a procedure which follow one another can be combined as a single function.
- The affordability of a product can be taken into consideration. The design of the product, together with an indication how it is to be used, facilitates its use (ISO 1503).
- Products can be used in as far as possible without an instruction manual. Complex tasks, e.g. maintenance, require additional documentation.
- Where procedures are complex, product control systems can make all essential steps and conditions known immediately to the user by feedback or by inquiry.
- Clear feedback precisely related to the situation for which it is needed minimizes the need to refer to instruction manuals or additional sources of information.
- Consistently designed feedback helps users to understand the process easily.
- Feedback that is adjustable to the expected knowledge of users also helps occasional users.

- Products can indicate their operating mode automatically and support two senses.
- An interruption in program sequences caused by the product (e.g. misoperation) not only results in the machine stopping but also indicates the cause of the interruption.
- Controls with the same design and layout can indicate the same function, even across devices.
- Operating sequences can be controllable and error-tolerant. Appropriate indications can be made to the user.
- Products fulfil the expectations of the user.
- The possibility of changing the operating condition of different products used in the same environment (such as the kitchen) in a uniform manner prevents users from dealing with different user interfaces.
- With products that are of similar type, the controls and displays have a similar arrangement. Feedback and control logic are also designed along the same lines.
- The possibility to adapt products and their programs to individual situations, abilities and preferences supports the specific user needs.
- Support and guidance in the dialogue between the user and the product can be given, such as explanations of options or next steps.

10.1.5 Immunological considerations (b435)

Allergies and hypersensitivities can be disabling when the need to avoid contact with the substance to which their body reacts and impose limitations on an individual's activities. Reactions can range from mild and annoying to sudden and life-threatening. Many products, foods and devices unnecessarily contain substances which can cause allergic responses.

Considerations should include to review ingredients of products, foodstuffs, etc. to identify the inclusion of substances that can cause reactions and where applicable provide appropriate labelling and warnings on this topic.

10.2 Product-specific design considerations

Article or substance that is offered for sale or is part of a service delivered by an organization. (ISO 26000, 2.15)

10.2.1 User interface and controls

10.2.1.1 General information

10.2.1.2 Operating the controls

The force required to twist, turn, push or pull controls or fastenings is significant for people with various impairments. Operating controls should allow comfortable grip, avoid twisting of the wrist, avoid the need for simultaneous actions and offer minimal resistance. Textured surfaces, to increase friction, assist the application of force. Provision of alternative controls offering greater leverage or power-assistance should be considered. Pre-programmable operation and personal preferred settings can be effective, particularly for people with cognitive impairment. [8.12.3.1]

Controls should be spaced to avoid interference when another one is being operated. [8.12.3.2]

10.2.1.3 Operations

These, such as the opening of packaging and assembling, installing or operating a product, should follow simple, straightforward and logical sequences. This assists persons with visual or cognitive impairment. [8.17.1]

10.2.1.4 Feedback

Consideration should be given to the provision of appropriate feedback when each action in a sequence of actions is successfully completed. [8.17.2]

Multisensory feedback should be provided on the status of controls. [8.12.3.3]

10.2.1.5 Repeated actions

Within a task, repetition can be helpful because it makes learning easier. (This may conflict with the needs of someone with a strength impairment, see 8.12.5.) Individuals with cognitive impairments can use most well designed controls and displays, but they take longer to learn to use them and need error protection. [8.17.3]

10.2.1.6 Suitability for the task

10.2.1.7 Suitability for learning

10.2.1.8 Duration of actions

Products should not need a long handling time and unnecessary repetition of operations should be avoided. [8.12.5]

10.2.1.9 Timed responses

Whenever possible, users should be able to control any limits on the amount of time available to them to read or respond. [8.12.6]

10.2.1.10 Slow pace of information presentation

Announcements spoken at a slow measured pace allow listeners to pick out the message; pauses between instructions give time to understand and act on the information. If a message is delivered too rapidly, it is difficult to assimilate by someone with a hearing or vision impairment, or learning disability. Consideration should be given to the length of time information remains in view when presented on moving displays, or when information is temporarily displayed and then removed. [8.10]

10.2.1.10.1 Operation not depending on user's memory

Persons with cognitive impairment and older persons tend to forget recently presented information or recently executed actions because of declines in short-term and working memory. Thus, minimizing the degree to which systems and products require memory of prior actions or operations facilitates accessibility. There is a variety of ways in which this can be accomplished, including the following:

- automated customer service applications over the phone can allow callers to pause or repeat messages;
- applications with visual displays can show a list of the most recent user actions or allow information that is referred to later to persist on the display;
- the appropriate pace of information presentation in electric marquee displays can facilitate comprehension of the users.

10.2.1.10.2 User control of time-sensitive content changes

Control of auditory information presentation

The following accessibility considerations are relevant to auditory information presentation, including prerecorded speech and synthetic speech.

- The comfortable speaking rate for broadcasting to older listeners is 6 to 7,2 mora/s. In contrast, the typical speaking rate in Japanese broadcasting is approximately 8 mora/s. Many blind persons prefer a faster speech rate, e.g. approximately two to four times the rate of normal speech. Adjustable speech rates covering the wide range of individual differences in preferred speech rate increases accessibility.

- Comprehension can be facilitated by lengthening the pauses between sentences, instead of or in addition to decreasing the rate of speech itself.

10.2.1.11 Time-constrained task design

Older persons and persons with cognitive impairments often cannot complete tasks or respond to stimuli in a specified or limited amount of time. If systems place limits on the time required for responses, the option to request additional time can increase accessibility for users to complete tasks. In those cases where time limits are set, such limits can be determined through evaluation of the expected user group.

10.2.2 Information, labelling, Instructions for use

10.2.2.1 Complexity of information

10.2.2.2 Special consideration for fonts used in electronic display screens

Visual appearance of self-luminous screen displays is different from reflected images used in printed information (hardcopy documents, books), and the difference affects accessibility of display design. In particular, the appearance of contrast and colour in self-luminous displays differs from that of reflected images, even if the physical characteristics of the light are the same.

10.2.2.3 Document navigation mechanisms

Clear and consistent navigation mechanisms increase the likelihood that people will find what they are looking for in a document and improve readability for all people.

Provision of information about the document layout (e.g. a table of contents for documents or a site map of a Web site) can increase accessibility.

10.2.2.4 Contents labelling and warning of allergens

10.2.2.4.1 Allergy labelling

When possible it is important for producers to avoid using known allergens and sensitizing substances. But, in cases, where allergens or sensitizing substances are contained in products, foodstuffs, or provided services it is important that they are clearly labelled. Information contained in labelling is used by individuals to avoid substances to which they have a hypersensitivity and thus avoid unnecessary allergic reactions and adverse effects.

Therefore, in addition to listing ingredients, a separate statement that declares any major allergens or sensitizing substances that may be included should clearly appear in the labelling close to the list of contents. Attention should also be drawn to any change in composition of significance in regard to allergens and sensitizing substances.

The risk of contact allergy and reaction to a foodstuff can be minimized by listing ingredients and declaring major allergens and sensitizing substances on the products, packaging materials, and other printed information. The information can be presented in alternative formats.

10.2.2.4.2 Warnings and cautions

Specific labels for “allergy-tested” products and packaging, as well as clear instructions for safe use or operation can be helpful. By placing warning and caution labels on products, packaging materials, and instruction booklets, the risk of inducing allergic reactions and adverse effects can be minimized for those with allergies and/or have been sensitized. Expressions such as, “Contains xxxxx” , “Trace of XXX may be contained ; “Those with xxxxx allergy should not use this product” can be used.

10.2.2.5 Expiration date marking

In order to reduce the risk of food poisoning, clear expiration date marking of food is important, as is the ability to interpret this. It is of particular value to those with an impairment in taste or smell. [8.13]

10.2.2.6 Other possible items

10.2.2.6.1 Language support

Persons who have difficulty in reading, writing or speaking often also have difficulty in using products and services safely and effectively.

The following accessibility considerations are relevant to language support.

- For users who have difficulty reading or who are illiterate:

    1. consider using speech displays for instructions and prompting of actions, as well as the use of multi media instructional material, including video instructions;

    2. consider the use of task-relevant graphics (e.g. illustrations or photographs) as a supplement or a substitute for text instructions.

- For users who have difficulty writing or typing, minimize the amount of writing or typing required, and consider substituting speech recognition as an input mechanism.

- Provide equivalent alternatives to speech input (e.g. use of keyboard) for users who have difficulty speaking or cannot speak.

- Provide multi-language user interfaces, if appropriate.

- Use simple, unambiguous and easy-to-understand language.

- Avoid difficult terms, complex grammatical structures and long sentences.

- Avoid use of the passive tense.

10.2.2.6.2 Handling and manipulation of user manuals

The size, number of pages and weight of paper used in an instruction manual can affect the ease with which it is held and pages are turned, which will influence the extent it is used. [8.12.2]

10.2.3 Containers and Packaging

Containers should allow easy opening and closing by adopting appropriate shapes, sizes and surface finish. Packaging, such as some food wrappings which are difficult to open can result in injuries as users resort to sharp knives or other gadgets to attempt opening. Operating forces should be as low as reasonably attainable, compatible with security of contents. [8.12.4]

10.2.3.1 Information and markings of packaging

10.2.3.1.1 Identification by form

A distinctive form can make it easier for those with visual impairment and reduced touch sensitivity to identify a product, to interpret the parts of a product to be joined during assembly and to distinguish between different controls. A familiar form can also aid those with impaired cognitive ability. [8.11.1]

10.2.3.1.2 Orientation of product or control

Where possible, the form of the product or control should also indicate the orientation of the product or control, so the top or bottom, front or back, can be easily located by someone with a visual impairment. [8.11.2]

10.2.3.1.3 Tactile warnings

The use of universally recognized tactile warnings on the container or packaging enables identification of toxic or corrosive materials. Similarly, tactile warnings are normally required in buildings, such as at stair openings, on steps, on platforms and at dangerous storage areas. [8.11.3]

10.2.3.2 Handling and manipulation of packaging

10.2.4 Surface finish

10.2.4.1 Slip-resistance and texture

The surface finish of a product/material is important for people with limited dexterity. A non-slippery surface aids gripping and manipulating. The use of distinct textures can also help someone with a visual impairment to distinguish different parts of a product or to locate controls. [8.18.1]

10.2.4.2 Sharp points

Surfaces should be free from sharp points and edges which are a potential hazard to anyone but are particularly so for someone with a visual or touch impairment. [8.18.2]

10.2.4.3 Non-glare surface finish

Some surfaces that have a polished finish or that are of a highly reflected material can cause glare by reflecting light or images. This reduces the visibility of these surfaces. Surface finish that minimizes glare can increase accessibility, particularly, for floors, visual displays and instruction papers.

10.2.5 Products Stationary or Portable (new)

10.2.6 Products combined or dismantled

10.2.7 Complex products (new)

10.2.8 Assembly and maintenance

The following accessibility considerations are relevant to the assembly and maintenance of products.

- With products that can be dismantled as intended for the individual components and the way they are handled.
- Cleaning and maintenance do not impair product features (i.e. surfaces, colours, printing and grip, etc.) which remain intact for the life of the product. [N0062, 8.12.8]

10.2.9 Fail-safe

Product or system design should ensure that even when incorrectly assembled or installed or there is mistaken use of controls, the product or system will fail in a safe manner without hazard to the user. [8.21]

10.2.10 Materials

Allergies and hypersensitivities can be disabling when a person is exposed to substance/s to which his/her body reacts and impose limitations on the individual's activities. Reactions can range from mild and annoying to sudden and life-threatening. Many products, foods and devices unnecessarily contain substances which can cause such responses.

Products, packaging foodstuffs, etc. should avoid inclusion of substances that can be toxic and/or cause allergic or hypersensitive reactions. If such ingredients/substances are included, appropriate labelling and warnings on this topic should be included with/on the product/product packaging (see also 8.2.2.4.1)

Table 1: Product-specific design considerations

Product-specific design considerations	Human abilities																		
	11.2 Sensory							11.3 Physical					11.4 Cognitive						11.5 Allergy
	Seeing 11.2.1		Hearing 11.2.2		Haptic/ tactile 11.2.3	Taste/ smell 11.2.4	Vestibular 11.2.5	Dexterity 11.3.1	Manipu-lation 11.3.2	Move-ment 11.3.3	Strength and Endurance 11.3.4	Speech/ Voice 11.3.5	Attention 11.4.2	Learning 11.4.3	Information processing 11.4.4	Memory 11.4.5	Judgment and Decision-Making	Language and literacy 11.4.4	Contact/ food/ respiratory
	Blind	Visual impaired	Deaf	Hearing impaired															
10.1.1 User interface and controls																			
10.1.2 Information, labelling, instructions for use																			
10.1.3 Containers and packaging																			
10.1.4 Surface finish																			
10.1.5 Products Stationary or Portable																			
10.1.6 Products combined or dismantled																			
10.1.7 Complex products																			
10.1.8 Maintenance																			

and cleaning																			
10.1.9 Fail-safe																			
10.1.10 Materials																			

10.3 Service-specific design considerations

Definition of service: Action of an organization to meet a demand or need. (ISO 26000, 2.16)

Table 2: Service-specific design considerations

Service-specific design considerations	Human abilities																			
	11.2 Sensory							11.3 Physical					11.4 Cognitive						11.5 Allergy	
	Seeing 11.2.1		Hearing 11.2.2		Haptic/ tactile 11.2.3	Taste/ smell 11.2.4	Vestibular 11.2.5	Dexterity 11.3.1	Manipu-lation 11.3.2	Move-ment 11.3.3	Strength and Endurance 11.3.4	Speech/ Voice 11.3.5	Attention 11.4.2	Learning 11.4.3	Information processing 11.4.4	Memory 11.4.5	Judgment and Decision-Making	Language and literacy 11.4.4	Contact/ food/ respiratory	
	Blind	Visual impaired	Deaf	Hearing impaired																
10.3.1 …																				

10.4 Built environment-specific design considerations

Products and technology that constitute an individual's indoor and outdoor human-made environment that is planned, designed and constructed for public use, including those adapted or specially designed. (ICF e150)

Built environment that which is commissioned, designed, constructed and managed for use by people and which includes the external and internal environments and any element, component or fitting that is a fixed part of them. (ISO 21512, definition 3.8)

Buildings

Product or system design should ensure that even when incorrectly assembled or installed or there is mistaken use of controls, the product or system will fail in a safe manner without hazard to the user. [8.3.2]

Elements in building and the built environment

Elements and parts of buildings such as windows, doors, bathroom-elements, lifts/elevators, lobbies, intercom systems, etc., should be accessible and easy to handle. This concerns the application of force, positioning, logical structure and having enough space to move around when using assistive devices.

The same applies to the built environment (for example, street furniture, pedestrian crossings, parking meters) and handling in public transport (doors, ticket machines, etc.).

These aspects are particularly valuable for those with impairments in seeing, balance, dexterity, manipulation, movement, strength and cognition. *See also 8.3 (Location and layout of information and controls and positioning of handles) and 8.16 (Accessible routes).* [8.12.7]

10.4.1 General considerations

Elements of the built environment are used by persons with a wide range of impairments, including residents, visitors, spectators, customers, employees, or participants in sports events, performances and conferences. Management and maintenance can affect safe access to, and use of, facilities by persons with disabilities.

A built environment designed to anticipate and overcome restrictions preventing disabled persons from making full use of premises and their surroundings increases accessibility. An accessible environment is one that a disabled person can enter and make use of independently or, if necessary, with the assistance of another person. New facilities can be designed to increase accessibility for persons with disabilities. In existing buildings, additional features such as handrails, tactile signs and hearing enhancement systems enhance accessibility.

10.4.2 Lighting of buildings

Adjustability of lighting levels in a building is desirable to suit different needs but sudden changes in lighting levels should be avoided. [8.4.3]

10.4.3 Acoustics

10.4.4 Air temperature

10.4.5 Indoor climate

10.4.6 Ventilation

Ventilation systems should not cause or enhance respiratory allergies or irritation. [8.22]

10.4.7 Clear floor or ground space

The following accessibility considerations are relevant to the maximum dimensions for clearance of a manually driven wheelchair (overall length 1 200 mm; width 700 mm in ISO 7193).

- The width is increased approximately 50 mm to 100 mm on each side for the elbows of the user. That means that the optimum width overall for wheelchair and elbows on both sides is 900 mm.
- Approximately 50 mm to 100 mm is added to the wheelchair length with respect to the user's protruding feet.

10.4.8 Maneuvering clearance

Buildings and other constructional facilities can be arranged to fulfil the fundamental geometric requirements of all persons with regard to areas of movement, areas of approach, movement spaces, height of handles and the ability to drive under objects.

10.4.9 Knee and toe clearance

Where space below an object such as a basin is added to clear floor, ground space or turning space, a design providing enough space for knee and toe clearance is required. Additional space below an object cannot be considered as part of the clear floor or ground space or turning space.

10.4.10 Protruding object

Protruding objects that do not reduce the clear width for accessible routes can increase accessibility.

10.4.11 Walking surfaces

The following is relevant to the design of walking surfaces:

- for walking surfaces that are a part of an accessible route;
- for floor or ground surfaces;
- the running slope of walking surfaces that is too steep can cause accessibility problems;
- for changes in level;
- walking surfaces that provide clearances can increase accessibility.

10.4.12 Elevators

10.4.13 Dimensions of passage for wheelchairs

The minimum width for wheelchair passage is affected by the physical dimension protruding from the wheel (elbows). The minimum free width of the passage is, for example, 900 mm. The intensity of use of' the corridor is used as a criterion for fixing the minimum width and length of the corridor.

10.4.14 Changes of levels

Accessibility in and around buildings can be improved by avoiding unnecessary changes in level at, for example, doorways and lift thresholds. Even very small changes of level, edges and protrusions can cause tripping. Where level changes cannot be avoided, they should be as low as possible, and clearly marked. [8.16.1]

10.4.15 Lift/elevators and ramps

Where there is a change of level, lifts/elevators and ramps should be provided. The slope of ramps should be appropriate in order to be safe and usable by persons using powered scooters, walking aids and wheelchairs. Lifts/elevators need to be of adequate size. [8.16.2]

10.4.15.1.1 Lifts/elevators

The following accessibility considerations are relevant to the design of lifts/elevators.

- Sufficient inside dimensions of elevator cars and a sufficient width of elevator doors for persons using walking aids and/or wheelchairs can increase accessibility.
- Width of doors,
- Handrails
- Controls and operable parts.
- A mirror can be installed inside facing the door of the lift so that the wheelchair users can see behind them.

10.4.15.1.2 Ramps

The following accessibility considerations are relevant to the design of ramps.

- The slope of ramps designed with considerations of the width, length and the landing length for wheelchairs, as well as the ease of handling of wheelchairs, can increase accessibility.
- Walking surface
- Changes of level
- Handrails.

10.4.16 Stairs

Any stairs and steps should be designed to accommodate older persons and persons with disabilities by providing handrails of an appropriate diameter and height on both sides. Steps should be of a consistent rise and tread to accommodate the length of a human adult foot. Ends of flights of stairs should be marked by appropriate colour contrast. [8.16.3]

10.4.16.1.1 General

The following accessibility considerations are relevant to the design of stairs.

- Stairs (in particular the main staircase) that have straight runs can increase accessibility.
- Steps on a flight of the stairs that all have uniform riser heights and uniform tread depths can increase accessibility.
- The following increases accessibility: two times riser + tread = 630 mm. A riser of 170 mm and a tread of 290 mm can be optimum for the widest range of people.
- Spiral staircases are not accessible, because the optimal step dimension only applies in the middle of the steps. When using handrails, the outer parts of the step of a spiral staircase have to be used.

- In public buildings, the provision of landings every 12 upward steps at maximum can increase accessibility.
- The use of stairs that have handrails can increase in accessibility.
- Open risers can cause accessibility problems.
- When designing stair treads and landings subject to wet conditions, slip resistance can increase accessibility.
- Clearly visible steps through the use of contrast in brightness and colour, at least at the edge of each step, can increase accessibility. The areas at the approach to stairs, both at bottom and top levels, can be marked to draw attention.

10.4.16.1.2 Handrails

Handrails are required on ramp runs with a rise greater than, for example, 150 mm, and on stairways. Handrails are not generally required on walking surfaces with running slopes less than a certain ratio, for example, 1:20, but some people need them even for a flatter slope.

The handrail is most effective when its height is approximately equal to the height of the hip joint. The muscular skeletal load is minimal when the height of the handrail is approximately equal to the height of trochanter major. The height of handrails can therefore be set at the averaged height of the hip joint of their users. The appropriate height for door handles is approximately the same as the height of handrails. Handrail height cannot be used to set the height of any safety barrier.

10.4.17 Flooring

Flooring should be reasonably slip-resistant, firm and stable: see 8.18.3. Floor guidance for visually impaired people should be provided. [8.16.4]

Floors should be slip-resistant to facilitate movement by those with a visual impairment, impaired balance and general difficulty in movement. Cushioned carpeting is not recommended as a springy surface does not offer a firm, stable foothold and deep-pile carpet causes resistance for those with a shuffling gait, risking a stumble. This type of carpet can also be a hazard for people using walking aids. A change of surface material can cause a danger and should be indicated. [8.18.3]

10.4.18 Swing, sliding or powered door-closing systems

These can knock people off balance and should incorporate appropriate safety mechanisms. Consider alternative controls such as (hands-free) automatic operation. The timing of any procedure or operation should allow more time for people who move slowly. [8.16.5]

10.4.19 Seating

This should be provided at appropriate locations in a facility or environment to enable users to rest. [8.16.6]

10.4.20 Coverage

Accessibility should be planned for all areas where people normally work or use the environment; it should be ensured that the accessible routes connect those areas by the shortest possible path. Care should be given to the inclusion of sanitary facilities within the accessible routes. [8.16.7]

10.4.21 Route information

Guidance on accessible routes through a building is of particular value to those with a visual, movement or cognitive impairment. [8.16.8]

10.4.22 Emergency routes

It is essential that emergency evacuation routes are obvious, intuitive and accessible to wheelchair users and others with a movement or visual impairment. [8.16.9]

10.4.23 Fire safety of materials

Consideration should be given to the fire-resistance qualities in products and buildings which are used by people with disabilities. Materials susceptible to ignition by a small source such as a cigarette, match or other small flame present a potential hazard if they continue to burn, producing toxic smoke or result in rapid growth of fire.

People who cannot move quickly or who do not see well are in particular at greater risk. [8.23]

10.4.24 Recreation design

10.4.25 Transportation-specific design considerations

... moving of persons or goods by road, paths, rail, air or water ... (ICF e5401)

Table 3: Built environment-specific design considerations

Built environment-specific design considerations	Human abilities																			
	11.2 Sensory							11.3 Physical					11.4 Cognitive						11.5 Allergy	
	Seeing 11.2.1		Hearing 11.2.2		Haptic/ tactile 11.2.3	Taste/ smell 11.2.4	Vestibular 11.2.5	Dexterity 11.3.1	Manipu-lation 11.3.2	Move-ment 11.3.3	Strength and Endurance 11.3.4	Speech/ Voice 11.3.5	Attention 11.4.2	Learning 11.4.3	Information processing 11.4.4	Memory 11.4.5	Judgment and Decision-Making	Language and literacy 11.4.4	Contact/ food/ respiratory	
	Blind	Visual impaired	Deaf	Hearing impaired																
10.4.2 Lighting of buildings																				
10.4.3 Acoustics																				
10.4.4 Air temperature																				
10.4.5 Indoor climate																				
10.4.6 Ventilation																				
10.4.7 Clear floor or ground space																				
10.4.8 Maneuvering clearance																				
10.4.9 Knee and toe clearance																				
10.4.10 Protruding object																				

10.4.11 Walking surfaces																			
10.4.12 Elevators																			
10.4.13 Dimensions of passage for wheelchairs																			
10.4.14 Changes of level																			
10.4.15 Lifts/elevators and ramps																			
10.4.16 Stairs																			
10.4.17 Flooring																			
10.4.18 Swing, sliding or powered door-closing systems																			
10.4.19 Seating																			
10.4.20 Coverage																			
10.4.21 Route information																			
10.4.22 Emergency routes																			
10.4.23 Fire safety of materials																			
10.4.24																			

Recreation design																			
10.4.25 Transportation-specific design considerations																			

11 Human abilities and characteristics and the consequences of/from impairment

11.1 General

The needs and abilities of people change as they advance from childhood to old age and the abilities of individuals in any particular age group vary substantially. It is important to recognize that functional and cognitive limitations vary from comparatively minor impairment to more extreme forms.

This clause, to be used in conjunction with clause 8, provides the tools for identifying and addressing the needs of older persons and persons with disabilities in standardization work. Codes for functions in this section are from the World Health Organisation's International Classification of Functioning, Disability and Health (ICF).

A brief description of each function has been given along with information on the relevant impairments, the effects of ageing and the practical implications of impairment. Examples have been given, where appropriate, of hazards which older persons and persons with disabilities are more at risk because of their impairments. [9.1]

- effects of ageing
- risks and hazards
- assistive technology
- multiple impairments/disabilities

11.2 Sensory functions (b200) [Sensory abilities]

Sensory functions are diverse, therefore several specific functions are presented in this section to facilitate understanding.

11.2.1 Seeing functions (b210) [Seeing]

Seeing relates to sensing the presence of light and sensing the form, size, shape and colour of visual stimuli. [9.2.1.1] The seeing function is comprised of a variety of aspects such as visual acuity, near and distance vision, accommodation to changes in focus, field of vision, perception of colour, distance (or depth), adaptation to changes in light levels, sensitivity to light.

11.2.2 Hearing functions (b230) [Hearing and speech]

Hearing functions relate to sensing the presence of sounds and discriminating the location, pitch, loudness, quality and comprehension of sounds. Hearing loss can range from a mild hearing impairment to deafness.

11.2.3 Touch functions (b265) [Haptic/tactile]

Touch functions relate to sensing surfaces and their texture or quality. [9.2.3.1] Included are functions of being sensitive to temperature, vibration, shaking, or oscillation, superficial pressure, deep pressure, burning sensation or a noxious stimulus.

11.2.4 Taste functions (b250)/smell functions (b255) [Taste/Smell]

Taste relates to sensing five basic qualities, through receptors on the tongue: bitter, sweet, sour, salt and umami. Smell relates to the use of receptors in the nose to sense odours and smells. The two senses of taste and smell are used together to identify the range of flavours which can normally be distinguished. [9.2.4.1]

11.2.5 Vestibular functions (b235)

11.3 Physical size, movement and voice functions

Several movement- related functions interact to achieve meaningful movement. Several specific functions and characteristics are presented in this section to facilitate understanding.

11.3.1 Human body size

Human size[1] is represented by measurements of the body in a number of fixed positions and weight. Anthropometric data sets represent the dimensions of people when standing, sitting, and with arms relaxed or outstretched (arm reach[3]). Consideration of an extension of the physical size should be taken in relation to attendant persons, service animals and assistive equipment including protective clothing, orthotics, personal mobility aids, a child's stroller, and luggage. Extremes in the mainstream in human body size ?

11.3.2 Movement-related structures and functions

11.3.2.1 Strength [Muscle power functions (b730)] and endurance (b740)

Muscle power functions relate to the force generated by the contraction of a muscle, or muscle group. Muscle endurance functions relate to the capacity to sustain force. This can also be related to heart and lung function.

11.3.2.2 Voluntary movement (b760) and involuntary movement (Tone) (b740)

Control of voluntary movement functions relate to controlling and coordinating voluntary movements, maintaining and changing the body position, and transferring from one area to another. Carrying, moving and manipulating objects, coordinated and skillful handling of objects, actions using hand and arms such as picking up, manipulating, and releasing objects and actions using legs, feet, arms and hands such as reaching, lifting, putting down, pulling, pushing, kicking, grasping, releasing, turning, throwing and catching are included. Muscle tone functions relate to the tension present in the resting muscle and the resistance offered when trying to move the muscle passively.

11.3.2.3 Balance (b755)

The ability to maintain balance and avoid falling is dependent on a complex system, which involves the brain coordinating visual stimuli, feedback from the balance mechanism in the ear and movement of the limbs. Continuous control of balance is required during virtually all types of activities. Balance functions include neuromusculoskeletal reflex to cope with fall.

11.3.2.4 Lower body structure (s750) and upper body structure (s730)

Prioritize extremes: amputees, range of motion. In movement.

11.3.2.5 Fine hand use activity (d440) and gross motor function

Prioritize extremes: amputees, range of motion. In movement.

11.3.3 Voice and speech functions (b310) [Speech/Voice (address speech production)]

Voice relates to the sound produced by the vocal organs, usually as speech. The speech function is comprised of a variety of aspects such as articulation, volume, fluency, speed, melody and rhythm. [9.3.5.1]

11.4 Mental functions (b100) [Cognitive abilities]

11.5 Immunological system functions (b435) [Allergies and hypersensitivity reactions]

Allergies (immunological reaction to a substance) and hypersensitivities (non-specific response to a substance) can cause mild and annoying to sudden and life-threatening reactions. They are generally divided into three categories: contact, food and respiratory. For the purposes of this clause chemical hypersensitives i.e. reactions to chemicals in the human environment are included.

ANNEX A [NEW ANNEX]

Examples for the application of the acessibility principles to different domains
(informative)

ANNEX B [NEW ANNEX]

(informative)

Main models of accessibility and disability

B.1 Introduction

B.1.1 This summary attempts to represent changes in social policy thinking, and progress in standards development thinking in the last decade. It is not exhaustive, and will doubtless attract calls for additional material.

B.1.2 There are two strands: historical and technological, reflected in this document, which are also reflected elsewhere in the emerging draft guide.

B.1.3 It is suggested, at this stage, that this chapter could either be combined with one on concepts, or could be a separate appendix, hence the numbering system in this draft.

B.2 Models and Accessibility

B.2.1 The Medical Model of Disability

B.2.1.1 Disabilities have traditionally been described with reference to medical conditions that they were seen to arise from. This is known as the medical model of disability and was encapsulated in the 1980 World Health Organisation's (WHO) International classification of impairments, disabilities, and handicaps. (1)

B.2.2 The Social Model of Disability

B.2.2.1 The main alternative to the medical model of disability is the social model. This has been highly influential, over the last 30 years, in shaping policy, practice and attitudes to disabled people.

B.2.2.2 The social model stemmed from the publication of Fundamental Principles of Disability in 1976. (2). This revolutionised the understanding of disability arguing that it was not mainly caused by impairments but by the way society was organised and responded to disabled people.

B.2.2.3 In the social model, disability is caused by society and is not the 'fault' of an individual disabled person, or an inevitable consequence of their limitations.

B.2.2.4 Disability is the product of the physical, organisational and attitudinal barriers present within society.

B.2.2.5 The social model takes account of disabled people as part of the economic, environmental and cultural society.

B.2.2.6 The WHO revised its definitions of disability, in part as a response to this social model, and from the realisation that the medical model was of very limited use in defining effective responses in meeting the needs of disabled people. In 2001 WHO published the International Classification of Functioning, Disability and Health (ICF) (3)

B.3 The Human Rights Model

B.3.1 A human-rights approach to disability has been affirmed in international documents and instruments for a number of decades. The documents and instruments were not legally binding but rather expressed a moral and political commitment that states should take in regard to persons with disabilities. Many of these instruments have been used by states as guidelines to enact legislation or to formulate policies concerning persons with disabilities such as

● the Declaration on the Rights of Disabled Persons (1995)

● the World Programme of Action concerning Disabled Persons (1981)

● the Principles for the Protection of Persons with Mental Illness and the Improvement of Mental Health Care (1991)

● the Standard Rules on the Equalization of Opportunities for Persons with Disabilities (1993).

B.3.2 The UN Convention on the Rights of Persons with Disabilities is the first legally binding instrument with comprehensive protection of the rights of persons with disabilities. It sets out and clarifies the obligations of States to promote, protect and ensure the rights of persons with disabilities. It is an international treaty that identifies the rights of persons with disabilities as well as the obligations on States parties to the Convention to promote, protect and ensure those rights. The Convention also establishes two implementation mechanisms: the Committee on the Rights of Persons with Disabilities, established to monitor implementation, and the Conference of States Parties, established to consider matters regarding implementation. The Convention, and Optional Protocol entered into force on 3 May 2008, after the Convention received its 20th ratification, and the Optional 'Protocol 10' ratifications. All signatories bind themselves to follow the principles laid out in the Convention. This marked a major milestone in the effort to promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms of persons with disabilities, and to promote respect for their inherent dignity.

B.4 Functional Models of Disability

B.4.1 Building on the social model the IMS Global Learning Consortium, introducing its work developing technical standards for accessibility in e-learning, offered a more education specific definition of both disability and accessibility (4). The term accessibility is widely used in the context of web design. The W3C describes web accessibility thus:

B.4.2 Web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web (5). This is in essence based on a functional model of disability. Generally in Human Computer Interaction (HCI) a functional approach is most useful. What is important in the design of web-based applications or content is how the diversity of users access the computer. This design can be said to be accessible if it facilitates full interaction by all users irrespective of assistive technologies or access approaches that may be adopted by some.

B.4.3 The AccessForAll 3.0 Personal Needs and Preferences (PNP) provides a specification that enables comprehensive profiles of individuals' access approaches and assistive technologies to be stored based on a functional model. This specification is being developed within the IMS Global Learning Consortium and went to public draft in September 2012 (6). These functional profiles could be generated by disabled people themselves, possibly with the help of advisors, inputting their specific access approaches and requirements to a web-form. Such profiles have great potential in personalization approaches to accessibility and in analytics based approaches to identifying accessibility issues.

B.4.4 The Universal Access Reference Model

B.4.4.1 One further example of a functional model is the Universal Access Model, which underpins the Principles in the Principles Clause of this guide. In this model, accessibility involves usable interaction

between a particular user and one or more objects in the user's environment for the purposes of accomplishing one or more tasks for the user. This recognizes that:

- 4.4.1.1 There might be many different users, who will each experience a different level of accessibility
- 4.4.1.2 These users can interact with a wide variety of objects, including: products, systems, services, facilities, built environments
- 4.4.1.3 Users tasks can be for personal or work related reasons

B.4.4.2 Barriers are anything that might interfere with the accessibility of interactions between users and the objects which are potential solutions to their task needs. A barrier can have one or many sources among the solution, the user, the interaction, and/or the environment.

B.4.4.3 This model focuses on the importance of removing the “barrier to the interaction rather than attributing blame to the source of the barrier.

B.4.4.4 The Universal Access Reference Model approach to these concepts uses a pipe metaphor to illustrate the flow of interactions between one user (from among many possible users) and the solution that is being interacted with and a valve metaphor to illustrate various levels of barriers to the interaction(s) between the user and the object. The shaded flow between user and solution illustrates the possibility of multiple communications occurring in either direction. A fully open valve represents the absence of any barriers to the interaction. A fully closed valve represents any interaction from taking place due to one or more barriers. Any other setting of the valve represents an interaction being partially impeded by one or more barriers.

B.4.5 User-Needs Model

B.4.5.1 ISO/IEC 29138-1 provides an extensive model of various user needs for different accessibility-related features in information technologies. Rather than focus on disabilities (which it does recognize as the basis for various of these needs), it focuses on properties (needs) of solutions that can lead to universal accessibility within its problem domain. In doing so, it combines many similar needs that can serve a wide range of disabilities, which developers can focus on without having to understand or deal with the wide variety of different disabilities and combinations of disabilities that exist.

B.4.5.2 ISO/IEC 29138-1 identifies user needs in terms of:

- The ability to perceive information
- The ability to understand
- The ability to perform actions
- Additional needs

B.4.5.3 While ISO/IEC 29138-1 is domain specific, similar user-needs models can be developed to serve other domains.

B.5 Conclusion

B.5.1 Our models of disability are important, they shape our attitudes and impact on how effectively the needs and preferences of disabled people are met in design.

B.5.2 The medical model is now widely seen as outmoded and a perpetuator of discriminatory attitudes.

B.5.3 The social model has had widespread influence. It is important in accessibility considerations because it recognises the importance of the context of the users and supports the view of accessibility as a relationship property; in the case of web accessibility the relationship being between the diversity of users and the web resource or application.

B.5.4 The Human Rights approach has gained significance with the adoption of the UN convention, which imposes important duties on signatory states to ensure their citizens enjoy greater protection and fuller participation in society, imposing consequent responsibilities on designers of Goods, facilities and services developed using international standards.

B.5.5 Functional models have been asserted as the most useful in design and development and the potential of these for personalisation and analytics highlighted.

B.5.6 The Universal Access Reference Model, (used in the development of ISO/IEC 24756:2009 Information technology -- Framework for specifying a common access profile (CAP) of needs and capabilities of users, systems, and their environments), is intended to be of broader relevance than to ICT or E-learning environments.

B.5.7 The User-Needs Model provides an extensive model of various user needs for different accessibility-related features in information technologies. similar user-needs models can be developed to serve other domains.

References

(All web-links checked 10 October 2012)

[1] World Health Organization, (1980) International classification of impairments, disabilities, and handicaps. A manual of classification relating to the consequences of disease. Geneva, WHO

[2] UPIAS, (1976) Fundamental Principles of Disability, London: Union of Physically Impaired against Segregation, available on-line at:

http://www.leeds.ac.uk/disability-studies/archiveuk/UPIAS/fundamental%20principles.pdf

[3] World Health Organization. (2001) International Classification of Functioning, Disability and Health. Geneva, WHO, Searchable online versions available at: http://www.who.int/classifications/icf/en/

[4] IMS Global Learning Consortium (2004) IMS AccessForAll Meta-data Overview. Available at:

http://www.imsglobal.org/accessibility/accmdv1p0/imsaccmd_oviewv1p0.html

[5] World Wide Web Consortium (2005). Introduction to Web Accessibility, available at: http://www.w3.org/WAI/intro/accessibility.php

[6] IMS Global Learning Consortium (2012) Access for All (AfA), Version 3.0 Specification, Public Draft 1.0. Primer and specification documents available from: http://www.imsglobal.org/accessibility/index.html

ANNEX C [NEW ANNEX]

(informative)

Approaches to applying accessibility in design

C.1 Introduction

Over time, the emphasis in designing accessible systems has evolved from "barrier-free design", through "accessible design" to "universal design". This evolution has changed the approach from treating accessibility as an added-cost of development (that developers might be forced to do) to a central aspect of development (that developers should recognize as the right thing to do).

C.2 Universal design, inclusive design, and design for all

Universal design and similar concepts (such as: inclusive design and design for all) refers to the attempt to make solutions usable to the widest range of users. These concepts go beyond concepts such as barrier-free design, by removing differentiations between persons with and without disabilities and including all persons as potential users within a diverse population. It is the intent of these concepts that "mainstream" solutions be usable by as many persons as possible. This does not mean that all users can be expected to use a solution in the same manner. These concepts recognize that we all can benefit from accessible solutions in various contexts throughout our lives.

NOTE There are minor distinctions between what each of these concepts means to the many people and organizations who use them. However, they all share the same basic meaning, which is distinct to previous concepts of accessible design and barrier-free design.

C.3 Accessible design

ISO/IEC Guide 71:2001 states that accessible design is

> "design focused on principles of extending standard design to people with some type of performance limitation to maximize the number of potential customers who can readily use a product, building or service which may be achieved by
>
> — designing products, services and environments that are readily usable by most users without any modification,
>
> — by making products or services adaptable to different users (adapting user interfaces), and
>
> — by having standardized interfaces to be compatible with special products for persons with disabilities.
>
> NOTE 1 Terms such as design for all, barrier-free design, inclusive design and transgenerational design are used similarly but in different contexts.
>
> NOTE 2 Accessible design is a subset of universal design where products and environments are usable by all people, to the greatest extent possible, without the need for adaptation or specialized design."

C.4 Barrier-free design

Barrier-free design refers to ensuring that solutions do not present barriers to their use by persons with disabilities.

ANNEX D [NEW ANNEX]

(informative)

Mapping between provisions in Guide 71 and the International Classification for Functioning, Disability and Health (ICF)

Bibliography [NEEDS UPDATING/REVIEW]

NOTE This Bibliography is not exhaustive: users are encouraged to check for current updates, future publications and investigate websites for much other material.

[1] ISO 3864-1, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for saftey signs in workplaces and public areas* (to be published)

[2] ISO 7176-5:1986, *Wheelchairs — Part 5: Determination of overall dimensions, mass and turning space*

[3] ISO 9999:2000, *Technical aids for disabled persons — Classification*

[4] ISO 9241-11:1998, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 11: Guidance on usability*

[5] ISO/TR 9527:1994, *Building construction — Needs of disabled people in buildings — Design guidelines*

[6] The Center for Universal Design's Universal Design File at: www.design.ncsu.edu/cud/pubs/center/books/ud_file/appendix.pdf

[7] JIS S 0011:2000, *Guidelines for all people including elderly and people with disabilities — Marking tactile dots on consumer products*

[8] JIS S 0012:2000, *Guidelines for all people including elderly and people with disabilities — Usability of consumer products*

[9] JIS S 0021:2000, *Guidelines for all people including elderly and people with disabilities — Packaging and receptacles*

[10] JIS X 6310:1996, *Prepaid cards — General specification*

[11] Kyoyo-Hin White Paper 2001, Definition, background scale of the market and sample list of Kyoyo-Hin and Kyoyo services http://Kyoyohin.org/eng/

[12] European Concept for Accessibility, European Commission, March 1996. www.eca.lu

[13] Product Safety Guide for the Elderly, Dutch Consumer Safety Institute, 1999 cd-rom www.eisenwijzer.nl

[14] Universal Design, Planning and Design for All, Norwegian State Council on Disability, 1997

[15] Principles for Older Persons, United Nations, 1991

[16] The Standard Rules on Equalization of Opportunities for Persons with Disabilities, United Nations, 1994

[17] Standards and the Elderly: Recommendations for Safety Improvements, Consumer Safety Institute, Netherlands and Consumers' Association, UK

[18] Handbook of Human Factors and the Older Adult, Fisk, A., Rogers, W. (Editors), ISBN 0-12-257680-2 Academic Press, Harcourt Brace, New York, Toronto, 1997

[19] The Universal Design File:Designing for People of All Ages and Abilities, Story, M.F., Mueller, J.L., Mace, D.L., The Center for Universal Design, NC State University, 1998

[20] Access By Design, Covington, G., Hannah, B., John Wiley and Sons, New York

[21] ANEC Guide: Meeting the Needs of Older Persons and People with Disabilities — Guidelines for Product Design and Testing (ANEC2000/SN/015-GL. At: www.anec.org./public/docweb/sn015-00.pdf and www.ricability.org.uk/anec/default.htm

[22] Handboek voor Toegankelijkheid (Handbook on accessibility, ergonomics of the built environment, buildings and houses), Dutch text, ISBN 90-5439-104-9, elsevier, Doetinchem, the Netherlands, 4 ed. 2001

NOTE ISO/TC 159 is currently working on a future Technical Specification, *Ergonomics of the thermal environment — Application of International Standards to the disabled, the aged and other handicapped persons,* and a future Technical Report, *Ergonomics of human-system interaction — Guidance on accessibility for human-computer interfaces*, although these are not yet publicly available. ISO/TC 145 is responsible for graphical symbols.

Title:
From AutoCAD Drawing "O
Creator:
AutoCAD

International Organization for Standardization
Case postale 56 • CH-1211 GENEVA 20 • Switzerland

International Electrotechnical Commission
Case postale 131 • CH-1211 GENEVA 20 • Switzerland

Ref. No.: ISO/IEC GUIDE 71:2001(E)

ICS 01.120; 11.180

Price based on 30 pages