BS EN 13861:2011

BSI Standards Publication

Safety of machinery — Guidance for the application of ergonomics standards in the design of machinery

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National foreword

This British Standard is the UK implementation of EN 13861:2011. It supersedes BS EN 13861:2002 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PH/9, Applied ergonomics.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Safety of machinery - Guidance for the application of ergonomics standards in the design of machinery

Sécurité des machines - Guide pour l'application des normes relatives à l'ergonomie dans la conception des machines

Sicherheit von Maschinen - Leitfaden für die Anwendung von Ergonomie-Normen bei der Gestaltung von Maschinen

This European Standard was approved by CEN on 11 September 2011.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Foreword

This document (EN 13861:2011) has been prepared by Technical Committee CEN/TC 122 “Ergonomics”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2012, and conflicting national standards shall be withdrawn at the latest by April 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13861:2002.

This document is intended to provide guidance for standardisers and manufacturers seeking to deal with the ergonomic requirements defined in EN ISO 12100:2010, 6.2.8, 6.3.2 and 5.3.2.

During the development of this document the Technical Committee has referred to the recommendations made within CEN/CENELEC Guide 6 to address the specific needs of older persons and persons with disabilities.

Annex A is normative; Annexes B, C and D are informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The designer of machinery is under an obligation to assess the risks during all phases of the life cycle of the machinery (see EN ISO 12100:2010, Clause 4). This includes knowledge and experience of the design, use, incidents, accidents and harm.

This European Standard elaborates EN ISO 12100:2010, Annex B as far as ergonomics are concerned. This standard refers to European and International ergonomics Standards in the various relevant fields.

The standards for ergonomic design of machinery, as referred to in this document, can help to avoid or reduce numerous hazards and risks, as assessed at the design stage, whilst considering the intended use, the expected use and the foreseeable misuse of the machinery.

1 Scope

This European Standard provides a methodology to achieve a coherent application of various ergonomics standards for the design of machinery. This standard presents a step model calling upon specific standards. To this end, Annex A shows a reference table with relation between hazards as described in EN ISO 12100:2010 and applicable B-standards related to ergonomics.

This European Standard can only be used in combination with other relevant ergonomics standards.

This European Standard provides guidance where no relevant or suitable ergonomics clauses in C-type standards are available.

This European Standard may also be used for incorporating ergonomics in the drafting of C-type standards (see Annex C for further information).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including amendments) applies.

EN 614-1, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 614-2, *Safety of machinery — Ergonomic design principles — Part 2: Interactions between the design of machinery and work tasks*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

CEN Guide 414:2004, *Safety of machinery — Rules for the drafting and presentation of safety standards*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and the following apply:

3.1
ergonomics
human factors
scientific discipline concerned with the understanding of the interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance (IEA[1)], 2000)

NOTE Adapted from prEN ISO 26800:2011.

3.2
machinery
machine
assembly, fitted with or intended to be fitted with a drive system consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application

1) International Ergonomics Association.

NOTE 1 The term "machinery" also covers an assembly of machines which, in order to achieve the same end, are arranged and controlled so that they function as an integral whole.

NOTE 2 EN ISO 12100:2010, Annex A provides a general schematic representation of a machine.

[EN ISO 12100:2010, 3.1]

3.3
operator
person or persons installing, operating, adjusting, maintaining, cleaning, repairing or moving machinery

[Machinery Directive 2006/42/EC, Annex I, 1.1.1]

4 Application of ergonomics standards in the design of machinery

4.1 Introduction

This standard provides a step-by-step approach for the application of ergonomics standards in the design of machinery. Users of this standard should select and use a C-type standard for that particular machine. For issues related to ergonomics the described step model may be used as guidance through the process of selecting the appropriate B-type ergonomics standards, whilst carrying out a risk assessment according to EN ISO 12100.

4.2 Process for guidance to the appropriate ergonomics standards

4.2.1 General

The guidance process is based on the general procedures for dealing with safety clauses. EN ISO 12100 provides a description of basic hazards, describes intrinsic design measures, and gives a list of examples for hazards, hazardous situations, and hazardous events that occur when using machinery. In order to meet the essential health and safety requirements, the machinery shall be designed in accordance with EN 614-1 and EN 614-2.

The following step model gives a methodology to achieve a coherent application of various ergonomics standards (see Figure 1).

4.2.2 Step 1: Hazard analysis and risk estimation

— Specify the limits of the machine with respect to ergonomics.

— Identify the hazards present at the machine during all modes of operation and at each stage in life of the machine by following the guidance in EN ISO 12100:2010, 5.4.

Ergonomic aspects of machinery can only be assessed, evaluated and verified when all intended interchangeable equipment of the machinery are known. Ergonomics requirements are necessary when considering 'the operator' and 'the exposed persons'.

Specifying the limits of the machinery during the life cycle phases as described in EN ISO 12100:2010, 5.3, involves the following ergonomics aspects:

Table 1 — Ergonomic aspects for specifying the limits of the machinery

External preconditions (characteristics and restrictions)	Work tasks (man/machine interface)
— Use limits (user groups)	— Intended and expected types of jobs
— Space limits	— Expected use of personal protective equipment
— Time limits — duration — frequency	— Foreseeable misuse
— Environmental conditions — climate — noise, lighting — vibration — dust, fume or other nuisances	

Annex B provides a checklist for listing the limits of the machinery.

4.2.3 Step 2: Investigation of applicability of standards

— Specify if a specific C-type standard exists.

— Check in the relevant C-type standard if the hazards generated by neglecting ergonomics principles and related risks are dealt with.

— Check which B-type standards may be used instead of or in addition to the relevant C-type standard.

If a relevant C-type standard is found, this should be followed first. Where appropriate, these C-type standards refer to A- and B-type standards for reduction of risks, which are likely to occur with the machinery involved. If no suitable C-type standard is available, or if the C-type standard concerned does not cover ergonomics related risks sufficiently, see Annex A for relevant B-type standards.

4.2.4 Step 3: Evaluation of the risks using relevant ergonomics standards

— Assess the remaining risks related to ergonomics.

— Check whether these risks are relevant.

— Consider the ergonomics standards mentioned in relation to the relevant risks (see Annex A).

— Check if these standards have been used to optimize the design of machinery.

In order to carry out the risk evaluation, the respective horizontal B-type standards on general and specific ergonomics related risks shall be considered. These standards are classified in Annex A (a short description of these standards can be found in Annex D).

Ergonomics related risks are significant if a human being and the machinery are part of a common work system (man machine interface). This interaction involves a mutual role as an interface as a tool, a fixture, an energy source or a link in a safety chain. See EN 614-1 and EN 614-2.

4.2.5 Step 4: Risk reduction using the various standards

Use one of the following alternatives:

— a solution as described in a C-type standard which refers to B-type standards for ergonomics where relevant;

— relevant B-type standards for ergonomics where no C-type standard is available;

— other (additional) references, related to ergonomics.

All the relevant and significant risks shall be reduced. However, there may be one or more reasons why some risks cannot be dealt with, e.g. there is no information available or the standard is restricted to some specific items.

If the use of personal protective equipment (PPE) has to be taken into account when designing the machine, an additional risk assessment shall be carried out in order to check that all essential health and safety requirements, including ergonomics, have been satisfied.

4.2.6 Step 5: Verification

— Check if all relevant and significant ergonomic related risks have been removed or reduced with the help of applicable standards.

— Check if there are significant risks that are not covered by any standard or other technical specification. In that case, (re)design the man machine interface in accordance with EN 614-1 and EN 614-2.

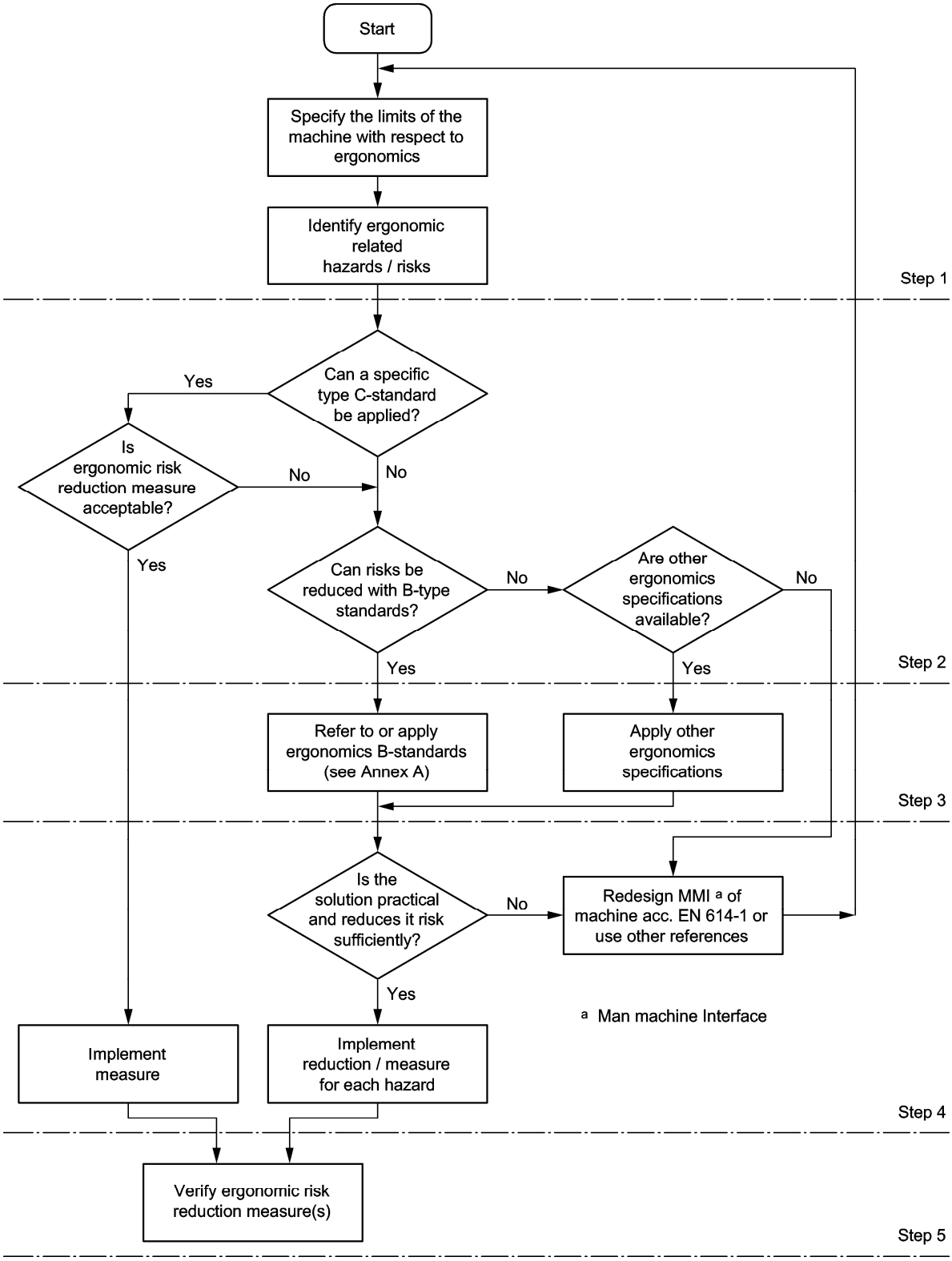

Figure 1 — Flowchart of the step model

5 Information for use

All residual ergonomics risks, which cannot be reduced sufficiently with help of specific C-type standards, horizontal B-type standards or other technical specifications, shall be dealt with in the user instructions for the machinery or in the chapter dealing with user instructions of the relevant C-type standard as stated in CEN Guide 414:2004, 6.10.

Any limitation in the use of the machinery shall be mentioned in these specifications. In addition, safety signs or pictograms may be prescribed.

Annex A
(normative)

Relation between hazards as described in EN ISO 12100 and applicable B-standards related to ergonomics

Table A.1

Number of EN ISO 12100: 2010, Annex B	**Type or group**[a]	Example of hazards[b]	**Type-B standards in the fields of ergonomics**			
		Origin EN ISO 12100:2010, Annex B	**Definition**	**Requirements/ design process**	**Measures**	**Verification or testing methods**
3	Thermal hazards	Flames or explosions and also by the radiation of heat sources	EN ISO 13732-1	EN ISO 13732-1	EN ISO 13732-1	EN ISO 13732-1
		Hot or cold surfaces and work environment	EN ISO 13731[c]	EN 27243[c] EN ISO 7730[c] EN ISO 11079[c]		EN ISO 7933[c] EN ISO 7726[c] EN ISO 8996[c] EN ISO 11064-6[c] EN ISO 13732-1 EN ISO 13732-3

Table A.1 *(continued)*

Number of EN ISO 12100: 2010, Annex B	**Type or group**[a]	Example of hazards[b]	**Type-B standards in the fields of ergonomics**			
		Origin EN ISO 12100:2010, Annex B	**Definition**	**Requirements/ design process**	**Measures**	**Verification or testing methods**
4	**Noise hazards**	Hearing loss (deafness), other physiological disorders	EN 1746[c]	EN ISO 11688-1 EN ISO 11688-2[c] EN ISO 11690-1[c] ISO 1999[a, c]	EN ISO 11688-1 EN ISO 11688-2[c] EN ISO 11690-2[c]	EN ISO 11200 EN ISO 11201 EN ISO 11204 EN ISO 3744 EN ISO 4871
		Interference with speech communication, acoustic signals, etc.	EN 1746[c]	EN ISO 7731[a] EN 894-2 EN ISO 11690-1[c] EN ISO 9921[c]	EN ISO 11688-1 EN ISO 11688-2[c] EN ISO 11690-2[c]	EN ISO 3744 EN ISO 4871 EN ISO 11200 EN ISO 11201 EN ISO 11204

Table A.1 *(continued)*

Number of EN ISO 12100:2010, Annex B	**Type or group**[a]	Example of hazards[b]	**Type-B standards in the fields of ergonomics**			
		Origin EN ISO 12100:2010, Annex B	**Definition**	**Requirements/ design process**	**Measures**	**Verification or testing methods**
		Noise at the work position	EN 1746[c]	EN 547-1 EN 547-2 EN 547-3 EN 1005-4 EN ISO 11201 EN ISO 11688-1 EN ISO 11688-2[c] EN ISO 11690-1[c] EN ISO 14738 ISO 1999[a, c]	EN ISO 11688-1 EN ISO 11688-2[c] EN ISO 11690-2[c]	EN ISO 11200 EN ISO 11201 EN ISO 11202 EN ISO 11203 EN ISO 11204 EN ISO 11064-6[c]
5	**Vibration hazards**	Use of hand-held machines	CR 12349[c] EN ISO 5349-1[c] ISO 2041[c] ISO 5805[c]	EN ISO 20643 EN ISO 5349-1[c] EN 28662-1[c]	CR 1030-1[c]	EN ISO 20643 EN ISO 5349-1[c] EN ISO 8041[c] EN ISO 5349-2[c] ISO 2631-1[c]

Table A.1 *(continued)*

Number of EN ISO 12100:2010, Annex B	**Type or group**[a]	Example of hazards[b]	**Type-B standards in the fields of ergonomics**			
		Origin EN ISO 12100:2010, Annex B	**Definition**	**Requirements/ design process**	**Measures**	**Verification or testing methods**
		Whole body vibration, particularly when combined with poor postures	EN 1032 CR 12349[c] EN 12786[c] ISO 2041[c] ISO 2631-1[c] ISO 5805[c] ISO 8727[c]	EN 1032	EN 1299	EN 1032 EN ISO 8041[c] EN 30326-1[c]
		Vibration at the work position	EN 12786[c] EN ISO 5349-1 ISO 2041[c] ISO 5805[c]	EN 547-1 EN 547-2 EN 547-3 EN ISO 14738 EN ISO 5349-1[c]	CR 1030-1[c]	EN ISO 20643 EN ISO 5349-1[c] EN ISO 8041[c] EN ISO 5349-2[c] ISO 2631-1[c]

Table A.1 *(continued)*

Number of EN ISO 12100:2010, Annex B	**Type or group**[a]	Example of hazards[b]	**Type-B standards in the fields of ergonomics**			
		Origin EN ISO 12100:2010, Annex B	**Definition**	**Requirements/ design process**	**Measures**	**Verification or testing methods**
6	**Radiation hazards**	Low frequency, radio frequency radiation, microwaves	EN 12198-1		EN 12198-1	
8	**Ergonomic hazards**	Unhealthy postures or excessive effort	EN 614-1 EN 1005-1 EN ISO 7250-1 EN ISO 9241-5[c]	EN 547-1 EN 547-2 EN 547-3 EN 614-1 EN 1005-2 EN 1005-3 EN 1005-4 EN 1005-5[c] EN ISO 14738 EN 60204-1 EN ISO 9241-5[c]	EN 547-2 EN 1005-2 EN 1005-3 EN 1005-4 EN 1005-5[c] EN ISO 7250-1 EN ISO 11064-2[c] EN ISO 14738 EN ISO 11064-4[c] EN ISO 14122-4	EN 1005-2 EN 1005-3 EN 1005-4 EN 1005-5[c] EN ISO 15537[c] EN ISO 15535[c]

Table A.1 *(continued)*

Number of EN ISO 12100:2010, Annex B	**Type or group**[a]	Example of hazards[b]	**Type-B standards in the fields of ergonomics**			
		Origin EN ISO 12100:2010, Annex B	**Definition**	**Requirements/ design process**	**Measures**	**Verification or testing methods**
		Inadequate consideration of hand-arm and foot-leg anatomy	EN 614-1 EN 1005-1 EN ISO 7250-1	EN 547-1 EN 547-2 EN 547-3 EN 614-1 EN ISO 14738 EN 60204-1	EN 547-2 EN 1005-2 EN 1005-3 EN 1005-4 EN 1005-5[c] EN ISO 7250-1 EN ISO 11064-2[c] EN ISO 14738	EN 1005-2 EN 1005-3 EN 1005-4 EN 1005-5[c] EN ISO 15535[c] EN ISO 15537[c]
		Inadequate local lighting	EN 614-1 EN 842 EN 894-2 EN 894-3 EN 12665[c] ISO 8995-1[c]	EN 614-1 EN 842 EN 894-2 EN 894-3 EN 894-4 EN 1837 EN 12464-1[c] EN 12464-2[c] EN 60204-1 EN 61310-1 EN ISO 11064-2[c] ISO 8995-1[c]	EN 12464-1[c] EN 12464-2[c]	EN 842 ISO 8995-1[c] EN ISO 11064-6[c] EN 12464-1[c] EN 12464-2[c]

Table A.1 *(continued)*

Number of EN ISO 12100:2010, Annex B	**Type or group**[a]	Example of hazards[b]	**Type-B standards in the fields of ergonomics**			
		Origin EN ISO 12100:2010, Annex B	**Definition**	**Requirements/ design process**	**Measures**	**Verification or testing methods**
		Mental overload and underload	EN 614-1 EN ISO 10075-1[c] EN ISO 9241-11[c]	EN 614-1 EN 614-2 EN 894-4 EN ISO 10075-2[c] EN ISO 9241-11[c]	EN 614-2	
		Human error, human behaviour	EN ISO 7731 EN 614-1 EN 614-2 EN 842 EN 894-1 EN 894-2 EN 894-3 EN 981	EN ISO 7731 EN 614-1 EN 614-2 EN 842 EN 894-1 EN 894-2 EN 894-3 EN 894-4 EN 981 EN 60204-1 EN 61310-1 EN 61310-2 EN 61310-3		EN ISO 7731 EN 842 EN 894-3 EN 981
		Fall of persons during access to (or at/from) the work position	EN 614-1 EN ISO 7250-1	EN 547-1 EN 547-2 EN 547-3 EN 614-1 EN ISO 14738		EN ISO 15537[c]

Table A.1 *(continued)*

Number of EN ISO 12100:2010, Annex B	**Type or group**[a]	Example of hazards[b]	**Type-B standards in the fields of ergonomics**			
		Origin EN ISO 12100:2010, Annex B	**Definition**	**Requirements/ design process**	**Measures**	**Verification or testing methods**
		Insufficient visibility from the work position	EN 614-1 EN 842 EN 894-2 EN 894-3 EN ISO 9241-300[c] EN ISO 9241-303[c]	EN 614-1 EN 61310-1 EN 61310-2 EN 842 EN 894-2 EN 894-4 EN ISO 9241-300[c] EN ISO 9241-303[c]	EN ISO 9241-306[c]	EN 894-3 EN ISO 9241-306[c]
		Inadequate lighting	EN 614-1 EN 12665[c] ISO 8995-1[c] EN ISO 9241-6[c]	EN 614-1 EN 1837 ISO 8995-1[c] EN ISO 9241-6[c] EN 12464-1[c] EN 12464-2[c]	EN 12464-1[c] EN 12464-2[c]	ISO 8995-1[c] EN 12464-1[c] EN 12464-2[c]
		Inadequate seating	EN 614-1 EN 1005-1 EN ISO 7250-1 EN ISO 9241-5[c]	EN 614-1 EN 1005-4 EN ISO 14738 EN 60204-1 EN ISO 9241-5[c] EN ISO 11064-4[c]	EN ISO 14738	EN 1005-4 EN ISO 15537[c]

Table A.1 *(continued)*

Number of EN ISO 12100:2010, Annex B	**Type or group**[a]	Example of hazards[b]	**Type-B standards in the fields of ergonomics**			
		Origin EN ISO 12100:2010, Annex B	**Definition**	**Requirements/ design process**	**Measures**	**Verification or testing methods**
		Inadequate location of controls/ control devices	EN 614-1 EN 894-2 EN 894-3 EN 894-4 EN 1005-1 EN ISO 7250-1	EN 614-1 EN 894-2 EN 894-3 EN 894-4 EN 1005-3 EN 1005-4 EN ISO 14738 EN 61310-2 EN 60204-1	EN ISO 14738	EN 894-3 EN 894-4 EN 1005-3 EN 1005-4 EN ISO 15537[c]
		Inadequate design of the actuation mode and/or action mode of controls	EN 614-1 EN 894-2 EN 894-3 EN 894-4 EN 1005-1 EN ISO 9241-110[c]	EN 547-1 EN 547-2 EN 547-3 EN 614-1 EN 894-2 EN 894-3 EN 894-4 EN 1005-3 EN 1005-4 EN 61310-2 EN 60204-1 EN ISO 9241-110[c]	EN 894-2 EN 894-4	EN 894-3 EN 894-4 EN 1005-3 EN 1005-4

Table A.1 *(continued)*

Number of EN ISO 12100:2010, Annex B	**Type or group**[a]	Example of hazards[b]	**Type-B standards in the fields of ergonomics**			
		Origin EN ISO 12100:2010, Annex B	**Definition**	**Requirements/ design process**	**Measures**	**Verification or testing methods**
		Insufficient visibility from the driving position	EN 614-1 EN 1005-1 EN ISO 7250-1	EN 547-1 EN 547-2 EN 547-3 EN 614-1 EN 894-2 EN 1005-4 EN ISO 14738 EN 60204-1	EN ISO 14738	EN 1005-4 EN ISO 15537[c]

[a] Only the clauses relating to ergonomics standards are included.

[b] For a detailed description of origin and potential consequences of hazards see EN ISO 12100:2010, Annex B.

[c] Standards that provide additional information beyond type-B standards according to CEN Guide 414.

Annex B
(informative)

Checklist for listing the limits[2)] of the machinery (step 1)

B.1 General

Prior conditions	**Life cycle phases**			
	Construction	Transport and commissioning — assembly, installation — adjustment	Use — setting, teaching/ programming or process changeover — operation — cleaning — fault finding — intervention resulting from malfunction — maintenance	De-commissioning, dismantling, disposal
External preconditions (characteristics and restrictions)				
User limits (user groups)				
Space limits				
Time limits — duration — frequency				

2) As defined in EN ISO 12100:2010, 5.3.

Prior conditions	Life cycle phases			
	Construction	Transport and commissioning	Use	De-commissioning, dismantling, disposal
Environmental factors, e.g.: — temperature — humidity — air velocity — noise — vibration — lighting — radiation — dusts — gases — vapours — bacteria — viruses — nanoparticles				
Work tasks (man/machine interface)				
Intended and expected use				
Expected use of personal protective equipment				
Foreseeable misuse				

B.2 External preconditions

B.2.1 User limits

Characteristics of an intended user group (the population that will use the machine) related to gender, age, skills, experience, abilities or temporal changes of physical and mental capabilities, including:

— younger, older and disabled persons, hand dominance, limiting abilities (such as visual/hearing impairments, size, strength, endurance);

— professional users, trainees and apprentices, general public;

— working hours or influence of other persons, e. g. workers in the vicinity, visitors, clients.

B.2.2 Space limits

The aspects to take into account include:

— the space required to install, to operate (including change of posture), to maintain, to clean and to repair;

— to dismantle the machine and the power supply;

— the space to access the machine and all its parts;

— the space inside the machine for body postures (e.g. driving positions);

— the range of motion of the operators and the working tools.

B.2.3 Time limits

The aspects to take into account include:

— the estimated duration and frequency of technical functioning of the machine;

— the duration and frequency of daily operation and/or supervision by the operators;

— the recommended service intervals.

B.2.4 Environmental conditions (of the intended work sites, NOT related to the machinery design)

In addition to the environmental factors given in the checklist, the following aspects should be taken into account:

— haptic effects (e.g. touch response, sensory return from actuators);

— kinematic effects (e.g. acceleration, posture balance);

— visual intrusion (e.g. vapours dim, glare, reflections, colour vision in inappropriate lighting);

— olfactory effects (e.g. odour).

B.3 Work tasks (man/machine interface)

B.3.1 Intended and expected use

Working tasks can be described by the following types or characteristics:

— production task;

— monitoring and supervising task;

— transportation task;

— general work or precision work;

— at a fixed work station or a mobile station;

— tasks performed in different postures, e.g. tasks carried out while sitting/standing/sitting and standing/walking, etc.;

NOTE Tasks performed in awkward postures should be avoided.

— tasks requiring a low force exertion: head/neck/eyes;

— tasks requiring a high force exertion: leg/foot/shoulder/arm/hand;

— tasks generating a high mental load or insufficient mental stimulation.

B.3.2 Expected use of personal protective equipment

— If it cannot be avoided in the foreseeable conditions of use;

— NOT related to the machinery design;

— Work which tends to increase the mental load.

B.3.3 Foreseeable misuse in terms of ergonomics (EN ISO 12100:2010, 3.24)

— Use by others than the intended user group;

— Use in an awkward working posture (e. g. static postures instead of varying and dynamic postures);

— Use for inappropriate purposes (other then specified by the users' guide);

— Use in inappropriate conditions, e.g. unsafe, unhealthy or unhygienic conditions;

— Use without proper training.

Annex C
(informative)

Additional requirements for C-type standardization

C.1 General

The following clauses are applicable when this standard is used for the drafting of ergonomics clauses in C-type standards. Additions to the respective clauses are given in C.2 to C.6.

C.2 To Clause 1 “Scope”

This European standard may be used for the drafting of C-type standards and by designers of machinery in an early design stage where no relevant or suitable C-type standards are available.

C.3 To 4.2.3, “Step 2: Investigation of applicability of standards”

Check which B-type standards shall be applied instead of, or in addition to this C-type standard.

Where appropriate, this C-type standard shall refer to A- and B-type standards for risks which are likely to occur with the machinery involved, but which are not dealt with (explicitly) in the specific C-type standard (see also CEN Guide 414:2004).

C.4 To 4.2.4,“Step 3: Evaluation of the risks using relevant ergonomics standards”

Assess the remaining risks. Check whether the risks are relevant. Consider the ergonomics standards mentioned in relation to the relevant risks (see Annex A). Check if these standards can be used as a generic basis for the C-type standard to provide the required risk reduction.

Ergonomics related risks are significant if a human being and the machinery are part of a common work system (man machine interface). This interaction involves a mutual possible role as an interface as a tool, a fixture, an energy source or a link in a safety chain. See EN 614-1 and EN 614-2.

C.5 To 4.2.5, “Step 4: Risk reduction using the various standards”

If some significant risks have not been dealt with in relevant A- and B-type standards, neither in this C-type standard, the exclusion of these significant risks shall be mentioned in the scope of the C-type standard, as stated in CEN Guide 414:2004.

C.6 To 4.2.6, “Step 5: Verification”

Check if the use of standards removed the relevant risks or reduced these risks to an acceptable level. As far as these standards do not help removing or reducing the risks sufficiently, additional specifications shall be drawn up in a C-type standard for the risks related to the specific machinery.

The C-type standard shall provide information on how the stated ergonomic measures can be verified by means of the information in the relevant horizontal B-type standards where available.

If there is no relevant B-standard, then a specific verification method shall be given in the C-type standard.

C.7 Requirements for residual risks

All residual risks which cannot be reduced sufficiently with help of specific C-type standards, horizontal B-type standards or other technical specifications, shall be dealt with in the user instructions for the machinery or in the chapter dealing with user instructions of the relevant C-type standard, see also CEN Guide 414:2004, 6.10.

Any limitation in the use of the machinery shall be mentioned in these specifications. In addition, safety signs or pictograms may be prescribed.

Annex D
(informative)

List of ergonomics standards applicable to the design of machinery safety standards

Where information is lacking because standards are not available, other sources of information in national standards and handbooks on ergonomics should be used.

EN 547-1:1996+A1:2008
Safety of machinery — Human body measurements — Part 1: Principles for determining the dimensions required for openings for whole body access into machinery
Specifies the dimensions of openings for whole body access as applied to machinery as defined in EN 292-1. It provides the dimensions to which the values given in EN 547-3 are applicable. Values for additional space requirements are given in Annex A. Has been prepared primarily for non-mobile machinery, there may be additional specific requirements for mobile machinery.

EN 547-2:1996+A1:2008
Safety of machinery — Human body measurements — Part 2: Principles for determining the dimensions required for access openings
Specifies the dimensions of openings for access as applied to machinery as defined in EN 292-1. It provides the dimensions to which the values given in EN 547-3 are applicable. Values for additional space requirements are given in Annex A. Has been prepared primarily for non-mobile machinery, there may be additional specific requirements for mobile machinery.

EN 547-3:1996+A1:2008
Safety of machinery — Human body measurements — Part 3: Anthropometric data
Specifies current requirements for human body measurements (anthropometric data) that are required by EN 547-1 and EN 547-2 for the calculation of access opening dimensions as applied to machinery. The anthropometric data originate from static measurements of nude persons and do not take into account body movements, clothing, equipment, machinery operating conditions or environmental conditions.

EN 614-1:2006+A1:2009
Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles
Establishes the ergonomics principles to be followed during the process of design of machinery. Although the principles in this standard are orientated towards equipment for occupational use, they are applicable also to equipment for private use. This standard applies to the interactions between the operator and the work equipment when installing, operating, adjusting, maintaining, cleaning, repairing or transporting equipment and outlines the principles to be followed in taking the health and safety of the operator fully into account. The ergonomics given in this standard fully apply to all ranges of individual ability. Information on dimensions will need to be interpreted to suit the intended population.

EN 614-2:2000+A1:2008
Safety of machinery — Ergonomic design principles — Part 2: Interactions between the design of machinery and work tasks
Establishes the ergonomics principles and procedures to be followed during the design process of machinery and operator work tasks. Deals specifically with task design in the context of machinery design, but the principles and methods may also be applied to job design. Is directed to designers and manufacturers of machinery and other work equipment. It will also be helpful to those who are concerned with the use of machinery and work equipment, e.g. to managers, organizers, operators and supervisors. The designer refers to the person or group of persons responsible for the design.

EN 842:1996+A1:2008
Safety of machinery — Visual danger signals — General requirements, design and testing
Specifies the safety and ergonomic requirements and the corresponding test methods for visual danger signals. It also provides guidance for the design of the signals to be clearly identified and distinguished as required in 5.3 of EN 292-2:1991. It does not apply to danger indicators - presented either in written or pictorial form - transmitted by data display units. Special regulations, such as those for public disaster and public transport, are not affected by this standard.

EN 894-1:1997+A1:2008
Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 1: General principles for human interactions with displays and control actuators
Applies to design of displays and control actuators on machinery. It specifies general principles for human interaction with displays and control actuators, to minimize operator errors and to ensure an efficient interaction between the operator and the equipment. It is particularly important to observe these principles when an operator error may lead to injury or damage to health.

EN 894-2:1997+A1:2008
Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays
Gives guidance on the selection, design and location of displays to avoid potential ergonomic hazards associated with their use. It specifies ergonomics requirements and covers visual, audible and tactile displays.

EN 894-3:2000+A1:2008
Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators
Gives guidance on the selection, design and location of control actuators so that they are adapted to the requirements of the operators and take account of the circumstances of their use. It applies to manual control actuators used in equipment for occupational and private use. It is particularly important to observe the recommendations in this Standard where operating a control actuator may lead to injury or damage to health, either directly or as a result of a human error.

EN 894-4:2010
Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 4: Location and arrangement of displays and control actuators
Contains ergonomic requirements for the location and arrangement of displays and control actuators in order to avoid hazards associated with their use. It applies to displays and control actuators for machinery and other interactive equipment (e.g. devices and installations, instrument panels, control and monitoring consoles). It is not applicable to the location and arrangement of displays and control actuators which are manufactured before the date of its publication.

EN 981:1996+A1:2008
Safety of machinery — System of auditory and visual danger and information signals
Is applicable to all danger and information signals which have to be clearly perceived and differentiated as specified in 5.3 of EN 292-2:1991, by other requirements or by the work situation, and to all degrees of urgency - from extreme urgency to an ALL CLEAR situation. Where visual signals are to be complementary to sound signals, the signal character is specified for both.

EN 1005-1:2001+A1:2008
Safety of machinery — Human physical performance — Part 1: Terms and definitions
Provides terms and definitions on concepts and parameters used for EN 1005-2, EN 1005-3, EN 1005-4 and EN 1005-5. Basic concepts and general ergonomic principles for the design of machinery are dealt with in EN 292-1, EN 292-2 and EN 614-1.

EN 1005-2:2003+A1:2008
Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery
Specifies ergonomic recommendations for the design of machinery concerned with manual handling in industrial and professional applications. This standard applies to the manual handling of objects of 3 kg or more. The standard provides data for ergonomic design and risk assessment concerning lifting, lowering and carrying in relation to the construction, transport and commissioning (assembly, installation, adjustment), use (operation, cleaning, fault finding, maintenance, setting, teaching or process changeover) and decommissioning, disposal and dismantling of machinery.

EN 1005-3:2002+A1:2008
Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation
Presents guidance to the designer of machinery or its component parts and the writer of C-Standards in controlling health risks due to machine-related muscular force exertion. Specifies recommended force limits for actions during machinery operation including construction, transport and commissioning (assembly, installation, adjustment), use (operation, cleaning, fault finding, maintenance, setting, teaching or process changeover) decommissioning, disposal and dismantling. Applies primarily to machines which are manufactured after the date of issue of the standard. Applies on one hand to machinery for professional use operated by the adult working population, who are healthy workers with ordinary physical capacity, and on the other hand to machinery for domestic use operated by the whole population including youth and old people. The recommendations are derived from research on European population.

EN 1005-4:2005+A1:2008
Safety of machinery — Human physical performance — Part 4: Evaluation of working postures and movements in relation to machinery
Presents guidance when designing machinery or its component parts in assessing and affecting health risks due only to machine-related postures and movements, i.e. during assembly, installation, operation, adjustment, maintenance, cleaning, repair, transport, and dismantlement. This European Standard specifies requirements for postures and movements without any or with only minimal external force exertion. The requirements are intended to reduce the health risks for nearly all healthy adults.

EN 1005-5:2007
Safety of machinery — Human physical performance — Part 5: Risk assessment for repetitive handling at high frequency
Presents guidance to the designer of machinery or its component parts and the writer of type C standards in assessing and controlling health and safety risks due to machine-related repetitive handling at high frequency. This European Standard specifies reference data for action frequency of the upper limbs during machinery operation, and it presents a risk assessment method intended for risk reduction option analysis. This European Standard applies to machinery for professional operation by the healthy adult working population. This European Standard is not applicable for repetitive movements and related risks of the neck, back and lower limbs.

CR 1030-1:1995
Hand-arm vibration — Guidelines for vibration hazards reduction — Part 1: Engineering methods by design of machinery
These guidelines outline feasible ways in which possible hand-arm vibration hazard associated with hand-held, hand-guided and other machinery may be reduced by machinery design in order to provide practical professional aid to designers and manufactures of machinery. The document covers four principal aspects of the reduction of the effects arising from exposure to hazardous machinery vibration:

— reduction of vibration magnitude at source;

— reduction of vibration transmission from the source to handless and other surfaces in contact with the hands;

— reduction of vibration transmission from the grips or handles of the machine to the hand-arm system of the operator by ergonomic design measures;

— thermal design to optimize hand temperature.

EN 1032:2003+A1:2008
Mechanical vibration — Testing of mobile machinery in order to determine the vibration emission value
Specifies the determination of whole-body and hand-arm vibration emissions at operator position(s) during type testing of mobile machinery. The purpose of this standard is to assist technical standardization committees responsible for specific types of machinery in preparing vibration test codes to ensure that such vibration test codes:

— enable users to make comparisons and to check the declared vibration emission values;

— are as homogeneous as possible with each individual test code having the same basic structure;

— are in full accordance with basic standards on measurement of vibration emission;

— reflect the latest technical knowledge of methods of determining the vibration emissions from the specific family of machinery under consideration.

EN 1299:1997+A1:2008
Mechanical vibration and shock — Vibration isolation of machines — Information for the application of source isolation
Gives guidelines to ensure that manufactures of machines provide adequate information on application of vibration isolation of their machines. Guidelines are also provided to ensure that users furnish sufficient information regarding their applications to suppliers to enable the optimum selection and design of vibration isolation. This standard is restricted to source isolation.

EN 1746:1998
Safety of machinery — Guidance for the drafting of the noise clauses of safety standards
Gives guidance on how to deal with noise in type C-Standards where noise is identified as a significant hazard. As such, this standard supplements the rules given in EN 414. The exact way that noise is dealt with for a particular type of machinery will depend on the structure of the type C-Standards and is the responsibility of the type C-Standard Technical Committees.

EN 1837:1999
Safety of machinery — Integral lighting of machines
Specifies the parameters of integral lighting systems designed to provide illumination in and/or at both stationary and mobile machines to enable the safe use of the machine and the efficient performance of the visual task within and/or at the machine to be carried out.

EN 12198-1:2000+A1:2008
Safety of machinery — Assessment and reduction of risks arising from radiation emitted by machinery — Part 1: General principles
Deals with the emission of radiation from machinery. This radiation emission may be intended for processing or may occur unintentionally. This standard is intended to give advice to C-type standardization groups, how to identify radiation emissions, how to decide on their significant and intensity, how to assess the possible risks and what means could be used to avoid or reduce radiation emissions. This advice should be elaborated in C-type standard for specific classes of machines into assessable requirements. This standard may also be used to give advice to manufactures for the construction of safe machinery, if no relevant C-type standard exists.

CR 12349:1996
Mechanical vibration — Guide to the health effects of vibration on the human body
Aim of this report is to provide information on the possible adverse health effects caused by exposure to vibration at work. The report addresses manufacturers as well as employers and employees using vibrating machinery in order to improve their understanding of the possible health problems arising from occupational exposure to vibration.

EN 12464-1:2002
Light and lighting — Lighting of work places — Part 1: Indoor work places
Specifies lighting requirements for indoor work places, which meet the needs of visual comfort and performance. All usual visual tasks are considered, including DSE (Display Screen Equipment).

EN 12464-2:2007
Light and lighting — Lighting of work places — Part 2: Outdoor work places
Specifies lighting requirements for outdoor work places, which meet the needs for visual comfort and performance. All usual visual tasks are considered.

EN 12665:2002
Light and lighting — Basic terms and criteria for specifying lighting requirements
Defines basic terms for use in all lighting applications; specialist terms with limited applications are given in individual standards. This standard also sets out a framework for the specification of lighting requirements, giving details of aspects which shall be considered when setting those requirements.

EN 12786:1999
Safety of machinery — Guidance for the drafting of the vibration clauses of safety standards
Gives guidance on how to deal with vibration in type C-standards where vibration is identified as a significant hazard. As such, this European Standard supplements the rules given in EN 414. The exact way that vibration is dealt with for particular machinery will depend on the structure of the type C-standards and is the responsibility of the type C-standards Technical Committees.

EN 27243:1993
Hot environments — Estimation of the heat stress on working man, based on the WBGT-index (wet bulb globe temperature) (ISO 7243:1989)
Gives a method, which can easily be used in an industrial environment, for evaluating the heat stress to which an individual is subjected in a hot environment and which allows a fast diagnosis. It applies to the evaluation of the mean effect of heat on man during a period representative of his activity, but it does not apply to the evaluation of heat stress suffered during very short periods, nor to the evaluation of heat stresses close to the zones of comfort.

EN 28662-1:1992
Hand-held portable power tools — Measurement of vibrations at the handle — Part 1: General (ISO 8662-1:1988)
Describes the basic requirements for evaluating vibrations in the handless of hand-held power-driven tools. It is not intended for assessment of human exposure to vibrations. The measurement and assessment of human exposure to hand-transmitted vibration in the workplace is given in EN ISO 5349 (all parts).

EN 30326-1:1994
Mechanical vibration — Laboratory method for evaluating vehicle seat vibration — Part 1: Basic requirements (ISO 10326-1:1992)
Specifies basic requirements for the laboratory testing of vibration transmission through a vehicle seat to the occupant. These methods for measurement and analysis make it possible to compare test results from different laboratories. It specifies the test method, the instrumentation requirements, the measuring assessment method and the way to report the test result. This part of the standard applies to specific laboratory seat tests which evaluate vibration transmission to the occupants of any type of seat used in vehicles and mobile off-road machinery. Application standards for specific vehicles should refer to this part of ISO 10326 when defining the test input vibration that is typical for the vibration characteristics of the type or class of vehicle or machinery in which the seat is to be fitted.

EN 60204-1:2006
Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)
Applies to the application of electrical, electronic and programmable electronic equipment and systems to machines not portable by hand while working, including a group of machines working together in a co-ordinated manner. The equipment covered by this standard commences at the point of connection of the supply to the electrical equipment of the machine (see 5.1). This standard is applicable to the electrical equipment or parts of the electrical equipment that operate with nominal supply voltages not exceeding 1.000 V for alternating current (a. c.) and not exceeding 1.500 V for direct current (d. c.), and with nominal supply frequencies not exceeding 200 Hz. This standard does not cover all the requirements (for example guarding, interlocking, or control) that are needed or required by other standards or regulations in order to protect persons from hazards other than electrical hazards. Each type of machine has unique requirements to be accommodated to provide adequate safety. This part specifically includes, but is not limited to, the electrical equipment of machines as defined in 3.35.

EN 61310-1:2008
Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)
Specifies requirements for visual, acoustic and tactile methods of indicating safety-related information, at the human-machine interface and to exposed persons. It specifies a system of colours, safety signs, markings and other warnings, intended for use in the indication of hazardous situations and health hazards and for meeting certain emergencies. It also specifies ways of coding visual, acoustic and tactile signals for indicators and actuators to facilitate the safe use and monitoring of the machinery. This standard is based on EN 60073 with regard to coding by colour and alternative means, but is not limited to electrotechnical aspects.

EN 61310-2:2008
Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking (IEC 61310-2:2007)
Specifies requirements for the marking of machinery. It gives general rules on marking for identification of machinery, for safe use related to mechanical and electrical hazards, and for the avoidance of hazards arising from incorrect connections.

EN 61310-3:2008
Safety of machinery — Indication, marking and actuation — Part 3: Requirements for the location and operation of actuators (IEC 61310-3:2007)
Specifies safety-related requirements for actuators, operated by the hand or by other parts of the human body, at the human-machine interface. It gives general requirements for:

— the standard direction of movement for actuators;

— the arrangement of an actuator in relation to other actuators;

— the correlation between an action and its final effects.

It is based on EN 60447 but is also applicable to non-electrotechnical technologies such as mechanical and fluid-powered systems. It covers single actuators as well as groups of actuators forming part of an assembly. This standard does not specify any requirements for "touch screens" (such information is given in EN 60073).

EN ISO 3744:1995
Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field conditions over a reflecting plane (ISO 3744:1994)
Specifies a method of measurement. Gives requirements for the test environment and instrumentation, as well as techniques for obtaining the surface sound pressure level from which the sound power level of the source is calculated, leading to results which have a grade of accuracy.

EN ISO 4871:2009
Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)
Gives information on the declaration of noise emission values, describes acoustical and product information to be presented in technical documents for the purposes of noise emission declaration, and specifies a method for verifying the noise emission declaration. It is applicable to machinery and equipment.

EN ISO 5349-1:2001
Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 1: General requirements (ISO 5349-1:2001)
Specifies general methods for measuring and reporting hand-transmitted vibration exposure in three orthogonal axes. It defines a frequency weighting and band-limiting filters to allow uniform comparison of measurements. The values obtained may be used to predict adverse effects of hand-transmitted vibration over the frequency range covered by the octave bands from 8 Hz to 1 000 Hz.

EN ISO 5349-2:2001
Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 2: Practical guidance for measurement at the workplace (ISO 5349-2:2001)
Provides guidelines for the measurement and evaluation of hand-transmitted vibration in the workplace. Describes the precaution to be taken to make representative vibration measurements and to determine the daily exposure time for each operation in order to calculate the 8-h energy-equivalent vibration total value (daily vibration exposure). Provides a means to determine the relevant operations which should be taken into account when determining the vibration exposure. Applies to all situations where people are exposed to vibration transmitted to the hand-arm system by hand-held or hand-guided machinery, vibrating workpieces, or control of mobile or fixed machinery.

EN ISO 7250-1:2010
Basic human body measurements for technological design — Part 1: Body measurement definitions and landmarks (ISO 7250-1:2008)
Provides a description of anthropometric measurements which can be used as a basis for comparison of population groups.

The basic list specified in this standard is intended to serve as a guide for ergonomists who are required to define population groups and apply their knowledge to the geometric design of the places where people work and live.

This list is not intended to serve as a guide for how to take anthropometric measurements, but it gives information to the ergonomist and designer on the anatomical and anthropometrical bases and principles of measurement which are applied in the solution of design tasks.

This standard is intended to be used in conjunction with national or international regulations or agreements to assure harmony in defining population groups. In its various applications, it is anticipated that the basic list will be supplemented by specific additional measurements.

EN ISO 7726:2001
Ergonomics of the thermal environment — Instruments for measuring physical quantities (ISO 7726:1998)
Specifies the minimum characteristics of instruments for measuring physical quantities characterizing an environment as well as the methods for measuring the physical quantities of this environment.

EN ISO 7730:2005
Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria (ISO 7730:2005)
Presents methods for predicting the general thermal sensation and degree of discomfort (thermal dissatisfaction) of people exposed to moderate thermal environments. It enables the analytical determination and interpretation of thermal comfort using calculation of PMV (predicted mean vote) and PPD (predicted percentage of dissatisfied) and local thermal comfort criteria, giving the environmental conditions considered acceptable for general thermal comfort as well as those representing local discomfort. It is applicable to healthy men and women exposed to indoor environments where thermal comfort is desirable, but where moderate deviations from thermal comfort occur, in the design of new environments or the assessment of existing ones. Although developed specifically for the work environment, it is applicable to other kinds of environment as well. It is intended to be used with reference to ISO/TS 14415:2005, 4.2, when considering persons with special requirements, such as those with physical disabilities. Ethnic, national or geographical differences need also to be taken into account when considering non-conditioned spaces.

EN ISO 7731:2008
Ergonomics — Danger signals for public and work areas — Auditory danger signals (ISO 7731:2003)
Specifies the physical principles of design, ergonomic requirements and the corresponding test methods for danger signals for public and work areas in the signal reception area and gives guidelines for the design of the signals. It may also be applied to other appropriate situations. The relevance given in the definitions as to the difference between an auditory emergency signal, auditory emergency evacuation signal and an auditory warning signal should be noted. The emergency evacuation signal is covered in ISO 8201. This International Standard does not apply to verbal danger warnings (e.g. shouts, loudspeaker announcements). ISO 9921 covers verbal danger signals. Special regulations such as those for a public disaster and public transport are not affected by this International Standard.

EN ISO 7933:2004
Ergonomics of the thermal environment — Analytical determination and interpretation of heat stress using calculation of the predicted heat strain (ISO 7933:2004)
Specifies a method for the analytical evaluation and interpretation of the thermal stress experienced by a subject in a hot environment. It describes a method for predicting the sweat rate and the internal core temperature that the human body will develop in response to the working conditions. The various terms used in this prediction model, and in particular in the heat balance, show the influence of the different physical parameters of the environment on the thermal stress experienced by the subject. In this way, this International Standard makes it possible to determine which parameter or group of parameters should be modified, and to what extent, in order to reduce the risk of physiological strains. The main objectives of this International Standard are the following: a) the evaluation of the thermal stress in conditions likely to lead to excessive core temperature increase or water loss for the standard subject; b) the determination of exposure times with which the physiological strain is acceptable (no physical damage is to be expected). In the context of this prediction mode, these exposure times are called "maximum allowable exposure times". This International Standard does not predict the physiological response of individual subjects, but only considers standard subjects in good health and fit for the work they perform. It is therefore intended to be used by ergonomists, industrial hygienists, etc., to evaluate working conditions.

EN ISO 8041:2005
Human response to vibration — Measuring instrumentation (ISO 8041:2005)
Specifies the performance specifications and tolerance limits for instruments designed to measure vibration values, for the purpose of assessing human response to vibration. It includes requirements for pattern evaluation, periodic verification and in-situ checks, and the specification of vibration calibrators for in-situ checks. Vibration instruments specified in this International Standard can be single instruments, combinations of instrumentation or computer-based acquisition and analysis systems. Vibration instruments specified in this International Standard are intended to measure vibrations for one or more applications, such as hand-transmitted vibration (see ISO 5349-1), whole-body vibration (see ISO 2631-1, ISO 2631-2, ISO 2631-4), and low-frequency whole-body vibration in the frequency range from 0,1 Hz to 0,5 Hz (see ISO 2631-1). Vibration instruments can be designed for measurement according to one or more of the frequency weightings defined within each of these applications. Three levels of performance testing are defined in this International Standard: a) pattern evaluation, i.e. a full test of the instrument against the specifications defined in this International Standard; b) periodic verification, i.e. an intermediate set of tests designed to ensure that an instrument remains within the required performance specification, and c) in-situ checks, i.e. a minimum level of testing required to indicate that an instrument is likely to be functioning within the required performance specification.

EN ISO 8996:2004
Ergonomics of the thermal environment — Determination of metabolic rate (ISO 8996:2004)
The metabolic rate, as a conversion of chemical into mechanical and thermal energy, measures the energetic cost of muscular load and gives a numerical index of activity. Metabolic rate is an important determinant of the comfort or the strain resulting from exposure to a thermal environment. In particular, in hot climates, the high levels of metabolic heat production associated with muscular work aggravate heat stress, as large amounts of heat need to be dissipated mostly by sweat evaporation. This International Standard specifies different methods for determination metabolic rate in the context of ergonomics of the climatic working environment. It can also be used for other applications; for example: the assessment of working practices, the energetic cost of specific jobs or sport activities, the total cost of activity, etc. The estimations, tables and other data included in this International Standard concern an "average" individual: - a man 30 years old weighing 70 kg and 1,75 m tall (body surface area 1,8 m²); - a woman 30 years old weighing 60 kg and 1,70 m tall (body surface area 1,6 m²). Users should make appropriate corrections when they are dealing with special populations including children, aged persons, people with physical disabilities, etc.

EN ISO 9241-5:1999
Ergonomic requirements for office work with visual display terminals (VDTs) — Part 5: Workstation layout and postural requirements (ISO 9241-5:1998)
Specifies ergonomic guiding principles which apply to the user requirements, design, and procurement of workstation equipment for office tasks using VDTs. In particular, the general principles and requirements specified in this part of EN ISO 9241 apply to the standards specifying technical design of furniture and equipment constituting the workplace.

EN ISO 9241-6:1999
Ergonomic requirements for office work with visual display terminals (VDTs) — Part 6: Guidance on the work environment (ISO 9241-6:1999)
Provides guidance on basic principles for the ergonomic design of the work environment and the workstation, taking into account lighting, effects of noise and mechanical vibrations, electrical and magnetic fields and static electricity, thermal environment, space organization and workplace layout. This part of EN ISO 9241 is applicable to the work environment and workstation in those work systems where a visual display terminal (VDT) is used for office work. However, this part of EN ISO 9241 does not specify the technical characteristics of the equipment needed to satisfy those equipment-related guidelines associated with the work environment.

EN ISO 9241-11:1998
Ergonomic requirements for office work with visual display terminals (VDTs) — Part 11: Guidance on usability (ISO 9241-11:1998)
Defines usability and explains how to identify the information which is necessary to take into account when specifying or evaluating usability of a visual display terminal in terms of measures of user performance and satisfaction. Guidance is given on how to describe the context of use of the product (hardware, software or service) and the relevant measures of usability in an explicit way. The guidance is given in the form of general principles and techniques, rather than in the form of requirements to use specific methods.

The guidance in EN ISO 9241-11 can be used in procurement, design, development, evaluation, and communication of information about usability. EN ISO 9241-11 includes guidance on how the usability of a product can be specified and evaluated. It applies both to products intended for general application and products being acquired for or being developed within a specific organization. It also explains how measures of user performance and satisfaction can be used to measure how any component of a work system affects the whole work system in use.

The guidance includes procedures for measuring usability but does not detail all the activities to be undertaken. Specification of detailed user-based methods of measurement is beyond the scope of EN ISO 9241-11, but further information can be found in Annex B and the bibliography in Annex E.

EN ISO 9241-11 applies to office work with visual display terminals. It can also apply in other situations where a user is interacting with a product to achieve goals. EN ISO 9241 parts 12 to 17 provide conditional recommendations which are applicable in specific contexts of use. the guidance in this Part of EN ISO 9241 can be used in conjunction with EN ISO 9241 Parts 12 to 17 in order to help identify the applicability of individual recommendations.

EN ISO 9241-11 focuses on usability and does not provide comprehensive coverage of all objectives of ergonomic design referred to in EN ISO 6385. However, design for usability will contribute positively to ergonomic objectives, such as the reduction of possible adverse effects of use on human health, safety and performance.

EN ISO 9241-11 does not cover the processes of system development. Human-centred design processes for interactive systems are described in EN ISO 13407.

EN ISO 9241-110:2006
Ergonomics of human-system interaction — Part 110: Dialogue principles (ISO 9241-110:2006)
Sets forth ergonomic design principles formulated in general terms (i.e. presented without reference to situations of use, application, environment or technology) and provides a framework for applying those principles to the analysis, design and evaluation of interactive systems. While this part of EN ISO 9241 is applicable to all types of interactive systems, it does not cover the specifics of every context of use (e.g. safety critical systems, collaborative work). It is intended for the following types of users:

— designers of user interface development tools and style guides to be used by user interface designers;

— user interface designers, who will apply the guidance during the development process;

— developers, who will apply the guidance during design and implementation of system functionality;

— buyers, who will reference this part of EN ISO 9241 during product procurement;

— evaluators, who are responsible for ensuring that products meet its recommendations.

This part of EN ISO 9241 focuses on dialogue principles related to the ergonomic design of the dialogue between user and interactive system, and does not consider any other aspect of design such as marketing, aesthetics or corporate design. The list of recommendations for each of the dialogue principles is not exhaustive.

EN ISO 9241-300:2008
Ergonomics of human-system interaction — Part 300: Introduction to electronic visual display requirements (ISO 9241-300:2008)
Provides an introduction to the other parts in the EN ISO 9241-300 subseries, and explains its modular structure. The EN ISO 9241-300 subseries establishes requirements for the ergonomic design of electronic visual displays. These requirements are stated as performance specifications, aimed at ensuring effective and comfortable viewing conditions for users with normal or adjusted-to-normal eyesight. Test methods an metrology, yielding conformance measurements and criteria, are provided for design evaluation. This part of EN ISO 9241 is applicable to the visual ergonomics design of electronic visual displays for a diversity of tasks in a wide variety of work environments.

EN ISO 9241-303:2008
Ergonomics of human-system interaction — Part 303: Requirements for electronic visual displays (ISO 9241-303:2008)
Establishes image-quality requirements, as well as providing guidelines, for electronic visual displays. These are given in the form of generic – independent of technology, task an environment – performance specifications and recommendations that will ensure effective and comfortable viewing conditions for users with normal or adjusted-to-normal eyesight. This part of EN ISO 9241 does not address issues of accessibility for people with disabilities. However, it does take into account aspects of the eyesight of older people an could be of value to people dealing with issues of visual impairment in certain cases: the specification of essential characteristics for normal viewing can be used to gauge the severity of different visual abnormalities so that appropriate solutions can be identified.

EN ISO 9241-306:2008
Ergonomics of human-system interaction — Part 306: Field assessment methods for electronic visual displays (ISO 9241-306:2008)
Establishes optical, geometrical and visual inspection methods for the assessment of a display in various contexts of use according to EN ISO 9241-303.

EN ISO 9921:2003
Ergonomics — Assessment of speech communication (ISO 9921:2003)
Specifies the requirements for the performance of speech communication for verbal alert and danger signals, information messages, and speech communication in general. Methods to predict and to assess the subjective and objective performance in practical applications are described and examples are given. In order to obtain optimal performance in a specific application, three stages can be considered: a) specification of the application and definition of the corresponding performance criteria; b) design of a communication system and prediction of the performance; c) assessment of the performance for in situ conditions. The use of auditory warning signals other than speech is not included in this International Standard but is covered by ISO 7731.

EN ISO 10075-1:2000
Ergonomic principles related to mental work-load — Part 1: General terms and definitions (ISO 10075:1991)
This international standard defines terms in the field of mental work-load, covering mental stress and mental strain, and specifies the relations between the concepts involved. It applies to the design of working conditions with respect to mental work-load and is intended to promote a common usage of terminology between experts and practitioners in the field of ergonomics as well as in general. It does not address methods of measurement and principles of task design, which are or will be dealt with in other international standards.

EN ISO 10075-2:2000
Ergonomic principles related to mental workload — Part 2: Design principles (ISO 10075-2:1996)
Gives guidance on the design of work systems, including task and equipment design, design of work places as well as working conditions. Relates to the adequate design of work and use of human capacities.

EN ISO 11064-2:2000
Ergonomic design of control centres — Part 2: Principles for the arrangement of control suites (ISO 11064-2:2000)
Covers ergonomic design principles for control centres, more specifically the various arrangements of rooms in a control suite. The principles are based on an analysis of tasks that have to be supported by the control room and functionally related rooms. They include identifying functional areas, estimating the space provisions for each functional area, determining operational links between all the activities conducted in the control suite. The control suite includes rooms or areas such as meeting rooms, equipment room, office(s), relaxation room and other rooms which support control room activities, as well as the control room itself.

EN ISO 11064-4:2004
Ergonomic design of control centres — Part 4: Layout and dimensions of workstations (ISO 11064-4:2004)
Specifies ergonomic principles, recommendations and requirements for the design of workstations found in control centres. It covers workstation design with particular emphasis on layout and dimensions. It covers primarily seated, visual-display-based workstations although sit/stand workstations are also addresses. These workstations are to be found in applications such as transportation control, process control and security installations.

EN ISO 11064-6:2005
Ergonomic design of control centres — Part 6: Environmental requirements for control centres (ISO 11064-6:2005)
Gives environmental requirements as well as recommendations for the ergonomic design, upgrading or refurbishment of control rooms and other functional areas within the control suite. The following aspects are covered: thermal environment (temperate regions); air quality; - lighting environment; acoustic environment; vibration; aesthetics and interior design. It is applicable to all types of control centres, including those for the process industry, transport and dispatching systems and emergency services. Although primarily intended for non-mobile control centres, many of its principles are relevant to mobile centres such as those found on ships, locomotives and aircraft. It does not cover the influence of electromagnetic fields. Guidance on the influence of electromagnetic fields on the image quality of visual displays is given in ISO 9241-6. This part of ISO 11064 is closely connected with ISO 11064-2 and ISO 11064-3, which describe the control room layout. It also relates to the design of equipment interfaces, which are influenced by environmental factors. It would be prudent for designers to also take account of the more general environmental requirements associated with display screen equipment use presented in ISO 9241-6 and ISO 9241-7.

EN ISO 11079:2007
Ergonomics of the thermal environment — Determination and interpretation of cold stress when using required clothing insulation (IREQ) and local cooling effects (ISO 11079:2007)
Specifies methods and strategies f or assessing the thermal stress associated with exposure to cold environments. These methods apply to continuous, intermittent as well as occasional exposure and type of work, indoors and outdoors. They are not applicable to specific effects associated with certain meteorological phenomena (e.g. precipitation), which are assessed by other methods.

EN ISO 11200:1995
Acoustics — Noise emitted by machinery and equipment — Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and other specified positions (ISO 11200:1995)
Provides brief summaries of the basic International Standards for determining emission sound pressure levels from all types of machinery at work station and at other specified locations and gives guidance on the process of selection. The guidance given does apply only to airborne sound.

EN ISO 11201:1995
Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Engineering method in an essentially free field over a reflecting plane (ISO 11201:1995)
Specifies a method for measuring the emission sound pressure levels of machinery and equipment at a work station and at other specified positions nearby, in an essentially free field over a reflecting plane.

EN ISO 11202:1995
Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Survey method *in situ* (ISO 11202:1995)
Specifies a method for measuring the emission sound pressure levels of machinery and equipment at a work station and at other specified positions nearby, in a semi-reverberant field. Emission sound pressure levels are measured as A-weighted or C-weighted peaks.

EN ISO 11203:1995
Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level (ISO 11203:1995)
Specifies two methods for determining the emission sound pressure levels of machinery and equipment at a work station and at other specified positions nearby, by calculation from the sound power level. Permits the comparison of the sound power of different units of a given family of machinery.

EN ISO 11204:1995
Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Method requiring environmental corrections (ISO 11204:1995)
Specifies a method for measuring the emission sound pressure levels of machinery and equipment at a work station and at other specified positions nearby, in any environment which meets certain requirements. Gives instructions for the installation and operation of the machine under test and for the choice of microphone positions for the work station.

EN ISO 11688-1:2009
Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)
Serves as an aid to understanding the basic concepts of noise control in machinery and equipment. The recommended practice presented is intended to assist the designer at any design stage to control the noise of the final product. Makes references to numerous technical publications dealing with acoustical problems.

EN ISO 11688-2:2000
Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design (ISO/TR 11688-2:1998)
Provides the physical background for the low-noise design rules and examples given in Part 1 and supports the use of extensive special literature. Is intended for use by designers of machinery and equipment as well as users and/or buyers of machines and authorities in the field of legislation, supervision and inspection. Equation given in this standard shall improve the general understanding of noise control. In many cases they allow a comparison of different versions of design, but they are not useful for the prediction of absolute noise emission values.

EN ISO 11690-1:1996
Acoustics — Recommended practice for the design of low-noise workplaces containing machinery — Part 1: Noise control strategies (ISO 11690-1:1996)
Outlines strategies to be used in dealing with noise problems in existing and planned workplaces by describing basic concepts in noise control (noise reduction, noise emission, noise immission and noise exposure). It is applicable to all types of workplaces and all types of sources of sound which are met in workplaces, including human activities. It includes those important strategies to adopt when buying a new machine or equipment.

EN ISO 11690-2:1996
Acoustics — Recommended practice for the design of low-noise workplaces containing machinery — Part 2: Noise control measures (ISO 11690-2:1996)
Deals with the technical aspects of noise control in workplaces. The various technical measures are stated, the related acoustical quantities described, the magnitude of noise reduction discussed and the verification methods outlined.

EN ISO 13731:2001
Ergonomics of the thermal environment — Vocabulary and symbols (ISO 13731:2001)
Defines physical quantities in the field of the ergonomics of the thermal environment. The corresponding symbols and units are also listed.

EN ISO 13732-1:2008
Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)
Provides temperature threshold values for burns that occur when human skin is in contact with a hot solid surface. It also describes methods for the assessment of the risks of burning, when humans could or might touch hot surfaces with their unprotected skin. This standard also gives guidance for cases where it is necessary to specify temperature limit values for hot surfaces; it does not set surface temperature limit values. Such temperature limit values can be specified in specific product standards or in regulations in order to prevent human beings sustaining burns when in contact with the hot surface of a product. This part of ISO 13732 deals with contact periods of 0,5 s and longer. It is applicable to contact when the surface temperature is essentially maintained during the contact (see 4.1).

EN ISO 13732-3:2008
Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 3: Cold surfaces (ISO 13732-3:2005)
Describes methods for the assessment of the risk of cold injury and other adverse effects when a cold surface is touched by bare hand/finger skin. This standard provides ergonomics data to establish temperature limit values for cold solid surfaces. The values established can be used in the development of special standards, where surface temperature limit values are required. The data of this standard will be applicable to all fields where cold solid surfaces cause a risk of acute effects: pain, numbness and frostbite. The data are not limited to the hands but apply to human skin in general. The standard is applicable to the healthy skin of adults (females and males). Considerations on the extension of applications are given in Annex B.

EN ISO 14122-4:2004
Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders (ISO 14122-4:2004)
Applies to all machinery (stationary and mobile) where fixed means of access are necessary. The purpose is to define the general requirements for safe access to machines mentioned in EN ISO 12100. EN ISO 14122-1 gives advice about the correct choice of access means when the necessary access to the machine is not possible directly from the ground level or from a floor. This standard applies to fixed ladders, which are a part of a machine. It may also be applied to fixed ladders to that part of the building where the machine is installed, providing the main function of that part of the building is to provide a means of access to the machine. This standard applies also to ladders which are not permanently fixed to the machine and which may be removed, moved to the side or pivoted (swivel-mounted) for some operations of the machine (e.g. changing tools in a large press).

EN ISO 14738:2008
Safety of machinery — Anthropometric requirements for the design of workstations at machinery (ISO 14738:2002, including Cor 1:2003 and Cor 2:2005)
Establishes principles for deriving dimensions from anthropometric measurements and applying them to the design of workstations at non-mobile machinery. It is based on current ergonomic knowledge and anthropometric measurements. This International Standard specifies the body's space requirements for equipment during normal operation in sitting and standing positions.

EN ISO 15535:2006
General requirements for establishing anthropometric databases (ISO 15535:2006)
Specifies general requirements for anthropometric databases and their associated reports that contain measurements taken in accordance with EN ISO 7250. It provides necessary information, such as characteristics of the user population, sampling methods, measurement items and statistics, to make international comparison possible among various population segments. The population segments specified are people who are able to hold the postures specified in EN ISO 7250.

EN ISO 15537:2004
Principles for selecting and using test persons for testing anthropometric aspects of industrial products and designs (ISO 15537:2004)
Establishes methods for determining the composition of groups of persons whose anthropometric characteristics are to be representative of the intended user population of any specific object under test. This International Standard is applicable to the testing of anthropometric aspects of industrial products and designs having direct contact with the human body or dependent on human body measurements, e.g. machinery, work equipment, personal protective equipment (PPE), consumer goods, working spaces, architectural details or transportation equipment. This International Standard is also applicable to the testing of such safety aspects of products that are dependent on human body measurements. It does not deal with other aspects of the task or other requirements, such as perception of information (except geometrical arrangement of the viewing targets) and the use of controls (except their geometrical placement). Although this International Standard deals with selecting test persons from an anthropometric perspective, similar general principles could be applied for other test variables, e.g. biomechanical aspects.

EN ISO 20643:2008
Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission (ISO 20643:2005)
Provides the basis for the drafting of vibration test codes for hand-held and hand-guided power driven machinery. It specifies the determination of hand-transmitted vibration emission in terms of frequency weighted root-mean-square (r.m.s.) acceleration during type testing. For machines where vibration test codes do not exist, it may also be used for determination of emission values and contains sufficient guidance for designing an appropriate test. This document is applicable to hand-held power tools (e.g. chipping hammers, sanders), hand-guided powered machines (e.g. lawn mowers, single-axle tractors, vibratory rollers) and other types of powered machines fitted with handles, guiding beams or similar means of control. It is applicable to machinery of all power sources (electrical, hydraulic, pneumatic, internal combustion engine, etc.). It does not apply to fixed machinery in which the vibration is transmitted to the hands of the user through the workpiece. This document is not applicable to vibration transmitted from steering wheels or control levers of mobile machinery where the operator's position is on the machine, see EN 1032. It is restricted to translational vibration measured in three orthogonal directions at the hand-machine interface. This document should be applied with caution to machines producing single and repetitive shocks with a frequency of occurrence lower than 5 Hz. For such machines, it is not known whether frequency-weighted root-mean-square acceleration values are related to the risks to health and additional measurements may be required. When developing vibration test codes for such machines the information in CEN ISO/TS 15694 should be considered. This document is not applicable to vibration test codes published before the date of publication of this document by CEN and, when used as test code, to hand-held and hand-guided machinery manufactured before that date. This document does not present limits or recommended vibration values. It does not give any guidance or recommendations for determination of human exposure to vibration at the workplace. For such information, reference is made to EN ISO 5349-1 and EN ISO 5349-2.

ISO 1999:1990
Acoustics — Determination of occupational noise exposure and estimation of noise-induced hearing impairment
Specifies a method for calculating the expected noise-induced permanent threshold shift in the hearing threshold levels of adult populations due to various levels and durations of noise exposure; it provides the basis for calculating hearing handicap according to various formulae when the hearing threshold levels at commonly measured audiometric frequencies, or combinations of such frequencies, exceed a certain value.

ISO 2041:2009
Mechanical vibration, shock and condition monitoring — Vocabulary
Defines terms and expressions unique to areas of mechanical vibration, shock and condition monitoring.

ISO 2631-1:1997
Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 1: General requirements
Defines methods for the measurement of periodic, random and transient whole-body vibration. It indicates the principal factors that combine to determine the degree to which a vibration exposure will be acceptable.

ISO 5805:1997
Mechanical vibration and shock — Human exposure — Vocabulary
Defines terms relating to human biodynamics or which are used in specific contexts in other standards pertaining to the evaluation of human exposure to mechanical vibration and shock. It provides standard definitions of terms and supplements ISO 2041 but does not contain general terms readily found in dictionaries.

ISO 8727:1997
Mechanical vibration and shock — Human exposure — Biodynamic coordinate systems
Specifies anatomical and basicentric coordinate systems for biodynamical measurements, for reference purposes in cognate standards development, and for precisely describing human exposure to mechanical vibration and shock. The segmental anatomical coordinate systems defined in this standard are for the head, root of the neck (driving-point for the head and neck system), pelvis, and hand. General principles are stated for the establishment of corresponding anatomical coordinate systems for other skeletal body segments. The biodynamic coordinate systems defined in this standard can serve as frames of reference for the description and measurement of both translational and rotational vibration and shock motion affecting humans.

ISO 8995-1:2002 (CIE S 008/E:2001)
Lighting of indoor work places — Part 1: Indoor
Specifies lighting requirements for indoor work places and for people to perform the visual tasks efficiently, in comfort and safety throughout the whole work period. It does not explain how lighting systems or techniques should be designed to optimise solutions for specific work places.

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