

**Published Standards from ISO Technical Committee 159 (Ergonomics),
Subcommittee 3 (Anthropometry and Biomechanics)**

ISO 7250-1:2008 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. It 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.

Comment: ISO 7250-1 does not include measurement data. It is definitions only. There are summary statistics of anthropometric data in ISO 7250-2.

ISO/TR 7250-2:2010 Basic human body measurements for technological design -- Part 2: Statistical summaries of body measurements from individual ISO populations

ISO/TR 7250-2:2010 provides statistical summaries of body measurements together with database background information for working age people in the national populations of individual ISO member bodies. The data are intended for use in conjunction with ISO standards for equipment design and safety, which require body measurement input, wherever national specificity of design parameters is required.

Comment: This TR is updated whenever new anthropometric data area available for an ISO population.

ISO 11226:2000/Cor 1:2006 Ergonomics -- Evaluation of static working postures

This International Standard establishes ergonomic recommendations for different work tasks. This standard provides information to those involved in design, or redesign, of work, jobs and products who are familiar with the basic concepts of ergonomics in general, and working postures in particular.

It specifies the recommended limits for static working postures without any or only with minimal external force exertion, while taking into account body angles and time aspects.

It is designed to provide guidance on the assessment of several task variables, allowing the health risks for the working population to be evaluated.

It applies to the adult working population. The recommendations will give reasonable protection for nearly all healthy adults. The recommendations concerning health risks and protection are mainly based on experimental studies regarding the musculoskeletal load, discomfort/pain, and endurance/fatigue related to static working postures.

Comment: ISO 11226:2000 provides a series of graphs for the head/neck, trunk, upper and lower extremities that present time limits for static postures given an angular degree of the range of motion for the particular body part and posture. These limits are based loosely upon the Rohmert recovery curve relationships and do not take into account any external loading.

ISO 11228-1:2003 Ergonomics -- Manual handling -- Part 1: Lifting and carrying

ISO 11228-1:2003 specifies recommended limits for manual lifting and carrying while taking into account, respectively, the intensity, the frequency and the duration of the task. ISO 11228:2003 is designed to provide guidance on the assessment of several task variables, allowing the health risks for the working population to be evaluated.

ISO 11228-1:2003 applies to manual handling of objects with a mass of 3 kg or more.

ISO 11228-1:2003 applies to moderate walking speed, i.e. 0,5 m/s to 1,0 m/sec on a horizontal level surface.

ISO 11228-1:2003 does not include holding of objects (without walking), pushing or pulling of objects, lifting with one hand, manual handling while seated, and lifting by two or more people. Holding, pushing and pulling objects will be included in other parts of ISO 11228.

ISO 11228-1:2003 is based on an 8 h working day. It does not concern analysis of combined tasks in a shift during a day.

Comment: The manual lifting limits presented in ISO 11228-1:2003 are based upon the NIOSH 1991 Revised Lifting Equation as modified by the European standard EN 10005-1 upon which this standard is based. As such, this standard presents different reference mass limits for different populations. The manual carry limits are based upon Stover Snook's and European work on carrying. Cumulative mass limits for repetitive lifting and carrying and risk reduction methods are also presented.

ISO 11228-2:2007 Ergonomics -- Manual handling -- Part 2: Pushing and pulling

ISO 11228-2:2007 gives the recommended limits for whole-body pushing and pulling. It provides guidance on the assessment of risk factors considered important to manual pushing and pulling, allowing the health risks for the working population to be evaluated. The recommendations apply to the healthy adult working population and provide reasonable protection to the majority of this population. These guidelines are based on experimental studies of push-pull tasks and associated levels of musculoskeletal loading, discomfort/pain, and endurance/fatigue.

Pushing and pulling, as defined in ISO 11228-2:2007, is restricted to the following: whole-body force exertions (i.e. while standing/walking); actions performed by one person; forces applied by two hands; forces used to move or restrain an object; forces applied in a smooth and controlled way; forces applied without the use of external support(s); forces applied on objects located in front of the operator; forces applied in an upright position (not sitting).

ISO 11228-2:2007 is intended to provide information for designers, employers, employees and others involved in the design or redesign of work, tasks, products and work organization.

Comment: ISO 11228-2:2007 incorporates abbreviated Mital, Nicholson and Ayoub push/pull psychophysical data from their publication *A Guide to Manual Materials Handling*, Second Edition, Taylor & Francis: London, 1997 as the "Method 1" for assessment whole-body push-pull tasks. "Method 2" presents a detailed biomechanical-based model utilizing strength and back compressive force to assess limits for whole-body push/pull tasks that do not fit the assumptions of the Mital, Nicholson and Ayoub data.

ISO 11228-3:2007 Ergonomics -- Manual handling -- Part 3: Handling of low loads at high frequency

ISO 11228-3:2006 establishes ergonomic recommendations for repetitive work tasks involving the manual handling of low loads at high frequency. It provides guidance on the identification and assessment of risk factors commonly associated with handling low loads at high frequency, thereby allowing evaluation of the related health risks to the working population. The recommendations apply to the adult working population and are intended to give reasonable protection for nearly all healthy adults. Those recommendations concerning health risks and control measures are mainly based on experimental studies regarding musculoskeletal loading, discomfort/pain and endurance/fatigue related to methods of working. ISO 11228-3:2006 is intended to provide information for all those involved in the design or redesign of work, jobs and products.

Comment: ISO 11228-3:2007 is addressed to upper extremity repetitive motion work and provides considerable detail on the Occupational Repetitive Actions (OCRA) method as the primary assessment tool. Screening and detailed versions of OCRA are presented and additional screening and assessment tools are listed and briefly discussed.

ISO 14738:2002/Cor 2:2005 Safety of machinery -- Anthropometric requirements for the design of workstations at machinery

1 Scope

This International Standard 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. This International Standard does not specifically include space demands for maintenance, repairing and cleaning work.

This International Standard does not give recommendations specifically for visual display terminal workstations at machinery. For this purpose ISO 9241-5 can be used in conjunction with this International Standard.

Situations where people are to be prevented from reaching a hazard are dealt with in ISO 13852.

Comment: The anthropometric data provided are European data and defined according to ISO 7250. The data are combined male/female data and only the 5th and 95th percentiles are given. This standard addresses primarily the determination of working height for various seated, sit-stand and standing workplaces although the annex B provides limited information for whole-body spacing required for dynamic activities.

ISO 15534-1:2000 Ergonomic design for the safety of machinery -- Part 1: Principles for determining the dimensions required for openings for whole-body access into machinery

This part of ISO 15534 specifies the dimensions of openings for whole-body access into machinery as defined in ISO/TR 12100-1. It provides the dimensions to which the values given in ISO 15534-3 are applicable. Values for additional space requirements are given in annex A. This part of ISO 15534 has been prepared primarily for non-mobile machinery; there may be additional specific requirements for mobile machinery.

Dimensions for passages are based on the values for either the 95th or 99th percentiles of the expected user population. Values for the 99th percentile apply to the emergency egress routes.

The anthropometric data given in ISO 15534-3 originate from static measurements of nude persons and do not take into account body movements, clothing, equipment, machinery-operation conditions or environmental conditions.

This part of ISO 15534 shows how to combine the anthropometric data with suitable allowances to take these factors into account.

Situations where people are to be prevented from reaching a hazard are dealt with in ISO 13852.

Comment: Specific whole-body access openings addressed include passageways for frontal or sideways movement, vertical movement through a duct using a ladder, “manhole”/utility opening access and kneeling access. This standard does not give actual access values – the user must refer either to ISO 7250, ISO 15534-3 or an anthropometric database with comparable measurement definitions in order to determine the appropriate dimensions. Space allowances for movement, fast movement and clothing and equipment are also provided.

ISO 15534-2:2000 Ergonomic design for the safety of machinery -- Part 2: Principles for determining the dimensions required for access openings

This part of ISO 15534 specifies the dimensions of openings for whole-body access into machinery as defined in ISO/TR 12100-1. It provides the dimensions to which the values given in ISO 15534-3 are applicable. Values for additional space requirements are given in annex A. This part of ISO 15534 has

been prepared primarily for non-mobile machinery; there may be additional specific requirements for mobile machinery.

Dimensions for passages are based on the values for either the 95th or 99th percentiles of the expected user population. Values for the 99th percentile apply to the emergency egress routes.

The anthropometric data given in ISO 15534-3 originate from static measurements of nude persons and do not take into account body movements, clothing, equipment, machinery-operation conditions or environmental conditions.

This part of ISO 15534 shows how to combine the anthropometric data with suitable allowances to take these factors into account.

Situations where people are to be prevented from reaching a hazard are dealt with in ISO 13852.

Comment: ISO 15534-2 provides access opening information for body parts as opposed to whole-body access. Access requirements for the upper body, arms, head, fist, hand, fingers and feet in different postures and orientation are provided. This standard does not give actual access values – the user must refer either to ISO 7250, ISO 15534-3 or an anthropometric database with comparable measurement definitions in order to determine the appropriate dimensions. An annex provides additional information and guidance on the positioning of access openings depending upon the type and body part requiring access.

ISO 15534-3:2000 Ergonomic design for the safety of machinery -- Part 3: Anthropometric data

This part of ISO 15534 specifies current requirements for human body measurements (anthropometric data) that are required by ISO 15534-1 and ISO 15534-2 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.

The data are based on information from anthropometric surveys representative of population groups within Europe comprising at least three million people. Both men and women are taken into account.

Measurements are given, as required by ISO 15534-1 and ISO 15534-2, for the 5th, 95th and 99th percentiles of the relevant population group within Europe.

Comment: ISO 15534-3 provides the limited suite of anthropometric data (in mm), taken from EN ISO 7250: 1996 keyed to the symbol notations used in ISO 15534-1 and 15534-2. The data reflect a combined male/female population and select 5th, 95th and 99th percentile values are given.

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 ISO 7250-1. 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 in ISO 15535:2006 are people who are able to hold the postures specified in ISO 7250.

Comment: ISO 15535 provides guidance on the creation of an anthropometric database, but is not itself a database. Summary data are found in ISO TR 7250-2.

ISO 15536-1:2005 Ergonomics -- Computer manikins and body templates -- Part 1: General requirements

ISO 15536-1:2005 establishes the general requirements for the design and development of computer manikins, body templates and manikin systems. It addresses their anthropometric and biomechanical properties, taking into account their usability and restrictions for structural complexity and functional versatility, and is also intended as a guide for the selection of manikins and manikin systems and for the evaluation of their accuracy and usability for the specified use. It specifies the documentation of the characteristics of manikins and manikin systems and their intended use, for the guidance of their users. It provides means for ensuring that computer manikins and body templates for the design of work space are appropriately accurate and reliable in their anthropometric and biomechanical aspects. It aims to ensure that users of manikins are able to choose an appropriate manikin system for particular design tasks and use it in an appropriate way. It sets requirements only on the static accuracy of the manikin, but provides recommendations on the other factors that can influence the accuracy of the analyses and determinations performed using them.

Comment: While intended as a prod for the developers of digital humans, this document is most useful for the purchaser of one of these systems. It provides a systematic way to make sure the user is specifying the best requirements for his/her needs.

ISO 15536-2:2007 Ergonomics -- Computer manikins and body templates -- Part 2: Verification of functions and validation of dimensions for computer manikin systems

ISO 15536-2:2007 establishes the requirements for the verification of the functions and validation of dimensions of computer manikins. These requirements concern the documentation of the data

employed to construct computer manikins and the methods employed to verify and validate their functions with regards to their dimensional accuracy.

ISO 15536-2:2007 extends to anthropometric and biomechanical data and to software functions as they are applied to create computer manikins. Although this document primarily refers to anthropometric data and methods, some biomechanical parameters are required to build and apply computer manikins and are therefore included.

ISO 15536-2:2007 provides a framework for reporting computer manikin accuracy and human-source data. The standard is intended to enable even non-specialist users of the manikin systems to independently perform measurements of each function under field testing conditions using automated software tools provided by developers.

It is not intended to require developers to perform specific verification and validation of their manikin systems.

Comment: Digital human application developers generally do not conduct tests of their products that verify their anthropometric and biomechanical accuracy. Instead, users need to perform these tests in context-specific environments. This standard provides a useful template for setting up and conducting such tests.

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.

ISO 15537:2004 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.

ISO 15537:2004 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).

Comment: Prototype products are often tested by living humans prior to final product release. This document outlines a method for selecting the right people to participate in those tests to assure that the product meets the needs of the full population range it is intended to serve.

**ISO/TS 20646-1:2004 Ergonomic procedures for the improvement of local muscular workloads --
Part 1: Guidelines for reducing local muscular workloads**

ISO/TS 20646-1:2004 provides information and guidelines to properly utilize various ergonomics standards concerning the factors related to local muscular workload (LMWL), and helps develop activities to reduce LMWL in workplaces, in an effective and efficient manner. ISO/TS 20646-1:2004 is intended primarily for employers, ergonomics and occupational health-related staff in enterprises, and workers. Specific measures to reduce LMWL can be applied to non-professional activities. Although ISO/TS 20646-1:2004 provides ideas of effective and efficient measures to reduce LMWL, it does not certify the complete prevention of health problems caused by LMWL.

Comment: This is a fairly general document that uses a checklist approach to preventing light (but repetitive) workload injuries. Other standards, especially the 11228 series approach this topic more rigorously, but this document also addresses organizational and cultural issues, such as how to implement an injury reduction program in an industrial setting. The organizational issues are not addressed in the 11228 series.

ISO 20685:2010 3-D scanning methodologies for internationally compatible anthropometric databases

ISO 20685:2010 addresses protocols for the use of 3-D surface-scanning systems in the acquisition of human body shape data and measurements defined in ISO 7250-1 that can be extracted from 3-D scans. It does not apply to instruments that measure the location and/or motion of individual landmarks.

While mainly concerned with whole-body scanners, it is also applicable to body-segment scanners (head scanners, hand scanners, foot scanners).

The intended audience is those who use 3-D scanners to create 1-D anthropometric databases and the users of 1-D anthropometric data from 3-D scanners. Although not necessarily aimed at the designers and manufacturers of those systems, scanner designers and manufacturers will find it useful in meeting the needs of clients who build and use 1-D anthropometric databases.

Comment: This standard was developed in response to those situations in which anthropometric data from 3D scanning surveys are collected more recently than traditional tape and caliper surveys. Since most ISO standards and design guidelines are based on historic traditional anthropometric data, users need to understand the differences between the data provided by 3D scanning surveys and the traditional data. This standard establishes benchmarks for determining comparability between the two data types.