DRAFT INTERNATIONAL STANDARD

ISO/DIS 14738

ISO/TC **159**/SC **3**

Secretariat: **JISC**

Voting begins on:
2020-04-15

Voting terminates on:
2020-07-08

Safety of machinery — Anthropometric requirements for the design of workstations for industries and services

ICS: 13.180; 13.110

This document is circulated as received from the committee secretariat.

ISO/CEN PARALLEL PROCESSING

Reference number
ISO/DIS 14738:2020(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14738 was prepared by the ISO Technical Committee TC 159, Ergonomics, Subcommittee SC 3, Anthropometry and biomechanics, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read "...this European Standard..." to mean "...this International Standard"...

Annex A forms a normative part of this International Standard. Annex B is for information only.

For the purposes of this International Standard, the CEN annex regarding fulfilment of European Council Directives has been removed.

Introduction

This International Standard is part of a set of ergonomics standards relating to anthropometry.

This International Standard describes how these ergonomics principles should be applied, using anthropometric requirements for the design of workstations in the industries (machinery) and services.

NOTE: Utility company offering services for individuals or professionals all service companies were in 2015 destined for half to companies that integrate them into their production process as consumptions Intermediate.

This concerns: trade, transport, accommodation and catering; Information and communication, financial and insurance activities but also scientific and technical activities, administrative and Support Services.

In addition, it is recommended that the postures and movements that are imposed by the machinery design are evaluated as described in ISO 11226.

This International Standard has been prepared to be a harmonized standard in the sense of the last Machinery Directive 2006-42 CE and associated EFTA regulations.

For work and workstations involving manual handling and repetitive tasks, designers are also advised to refer to ISO technical report TR 12295 Handling Ergonomics (an ergonomics application document for ISO standards on manual handling, ISO 11228-1, ISO 11228-2 and ISO 11228-3) and the Evaluation of Static Working Postures (ISO 11226).

Safety of machinery — Anthropometric requirements for the design of workstations for industries and services

1 Scope

This International Standard provides principles derived from the application of anthropometric data to the design of workstations. It is based on ergonomics and currently available anthropometric measurements.

This International Standard specifies the body's space requirements for normal operation of equipment in sitting, sit-standing and standing positions. It includes 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.

Safety distances intended to prevent hazard zones being reached by upper and lower limbs are provided in ISO 13857.

2 Normative references

This International Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed thereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this International Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

EN ISO 12100, *Machine Safety - General Principles of Design - Risk Assessment and Risk Reduction*

ISO 13857, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 7250-1, *Basic human body measurements for technological design — Part 1: Body measurement definitions and landmarks*

ISO/TR 7250-2, *Basic human body measurements for technological design — Part 2: Statistical summaries of body measurements from national populations*

ISO 7250-3, *Basic human body measurements for technological design — Part 3: Worldwide and regional design ranges for use in product standards*

EN 1005-3, *Safety of machinery - Human physical performance - Part 3: Recommended force limits for machinery operation*

EN 1005-4, *Safety of machinery - Human physical performance - Part 4: Evaluation of working postures and movements in relation to machinery*

ISO 11226, *Ergonomics — Evaluation of static working postures*

3 Terms and definitions

3.1 Percentile (P)

Percentiles are the values of the variable that divide the population or the continuous variable into 100 equal groups by number (1% of the population).

NOTE Are considered as normal the values situated between (P5) and (P95).

3.2 95e percentile

It is the value such that 95% of the measured values are below and 5% are above.

3.3 Raised sitting position

It is dependent on technical necessities, tasks at varying levels of work or maintaining the level of vision to that of the people standing. It has the same comfort advantages as sitting. On the other hand, it results in a greater difficulty in manipulating and positioning the seating medium in front of a workstation.

NOTE It increases the risk of falling by sitting or getting up, as well as the risk of tripping over the base. The footrest can be uncomfortable when climbing/descending the seat. The passage of the legs under the worktop should not be prevented.

3.4 Sitting Position

The sitting station, or sitting position, is a rest station of the human being, in which the body rests on the buttocks or the back of the thighs, with the trunk vertically.

3.5 Sit-standing position

The sit-standing position is suitable for situations where it is possible to adopt a fully seated position or a position associating the sitting and standing position. It helps to support a portion of the body weight and facilitates the return to a standing position.

3.6 Services

A service activity is characterized mainly by the provision of technical or intellectual capacity/delivery. Unlike an industrial activity, it cannot be described by the characteristics of a material property acquired by the customer. The line between material and intangible goods is also tenuous.

4 Task requirements

Design of workstations at machinery shall be based on an analysis of task requirements (see EN 614-1) including at least the following elements:

— time aspects e.g. duration of work (see ISO 11226);

— size of working area,

— size of objects to be handled;

— force demands (see EN 1005-2 and EN 1005-3);

— action demands (e.g. for feeding and/or removing items from the machinery);

— dynamic body measurements (see Annex B);

— coordination demands;

— stability demands;

— visual demands;

— need for communication;

— need to move between workstations;

— frequency and duration of body, head and limb movements (see ISO 11226);

— the possibility for adopting different postures (see ISO 11226).

Machinery and workstations shall be designed to avoid awkward postures and movement patterns taking into account technical and economic constraints.

5 Determination of main work posture

Prolonged work postures can be stressful and can cause muscle and joint discomfort. The most effective way to prevent or minimize these effects is to change postures regularly.

Indeed, maintaining prolonged static postures is not recommended. It has a negative effect on blood circulation, whereas changing postures can help to improve circulation. When blood circulation is improved, muscles are provided with the nutrients they need, and metabolic waste products are eliminated. In order to avoid prolonged sitting or standing postures, employees must be provided with the opportunities to change postures whenever possible and as needed.

Adjustable seating and work surfaces are recommended wherever possible to accommodate regular changes in posture. The operator must be able to make the changes to their posture as needed throughout the shift, depending on their own circumstances (e.g. ease of work, tolerance to certain positions, onset of discomfort, pre-emptively to avoid discomfort etc).

Figure 1 shows an analysis method for determining the preferred main work posture at a work station shows how some of the different factors described in clause 3 should be considered. Figure 1 also indicates how factors can be modified to allow a sitting posture. The design of the workstation, task and equipment shall allow for and some movement and shifting of posture. The design should also allow the operator to change freely between the sitting, standing and sit/standing posture during the working day. When the designer chooses the main work posture, a risk assessment shall be performed, following EN ISO 12100, which specifies the principles of risk assessment and reduction, relevant to the design and use of machines, as well as incidents, accidents and risks associated with them. Sitting and sit/standing postures are generally to be preferred and the standing postures are less recommended. Kneeling, crouching and lying down should be avoided as working postures.

The raised sitting position is generally not recommended. In the case of equipment requires special height, we have to consider the posture for lower limb as describe in the sitting posture (clause 7). If performing tasks requiring low force the raised sitting position is necessary and it shall follow the requirements of the sitting position (see clause 7).

Standing posture cannot be held all day. It is recommended to change position regularly. Some activities require many different tasks (eg repetitive tasks in manufacturing activities with two or three machines) and it is important to provide physiological recovery times every hour as recommended by OCRA method (ISO 11228-3).

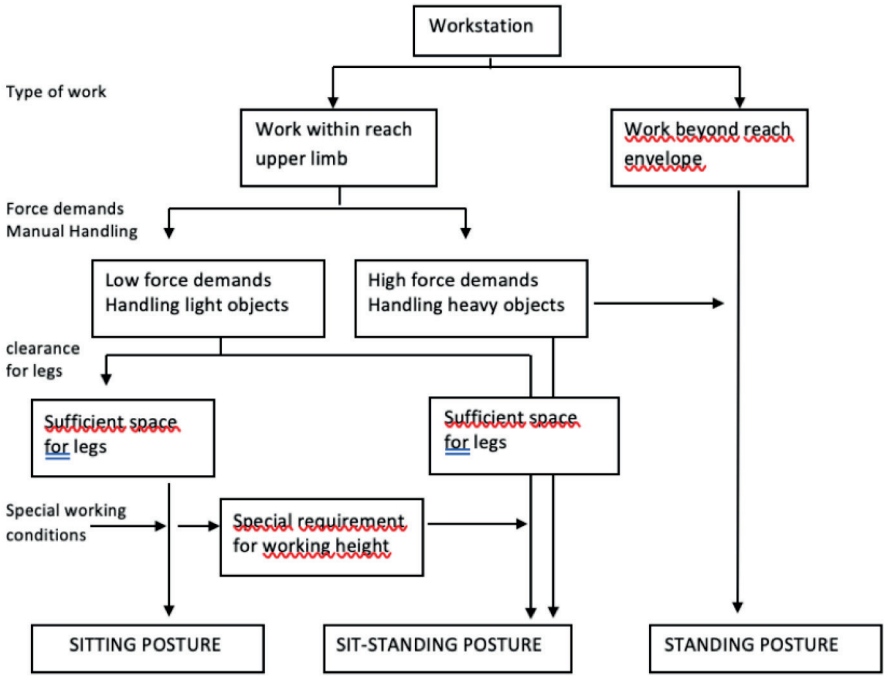

Figure 1 — Analysis method for determining main preferred work posture

6 Dimensional data for workstation design

Several calculation methods, relating to the design of the workstations, are given for each working position described in this standard. For dimensions, it is necessary to refer to the anthropometrics dimensions based on data from static measurements and on naked people. They do not take into account the movements of the body, the clothes and the equipment necessary for the activity as well as the working conditions and the physical environment. Annex A provides a table of the different body parts as it is possible to find them in ISO 7250-1 and anthropometric data in ISO 7250-3.

The dimensions given in Table 1 are based on practice, and complement the anthropometric benchmarks specified in the cited standards. All these data are used to specify the dimensions of the workstations.

Table 1 — Allowances and additional dimensions

Height allowances(x)[1]	x_1 - for shoes add 30 mm x_2 - for shoes and foot movements add 130 mm x_3 - for shoes and possibility to cross legs or for seat with forward sloping adjustment add 130 mm
Width allowances (y)	y - for movement of legs add at least 350 mm.
Depth allowances (z)	z_1- for movements at knee height add at least 50 mm z_2- for movements for the feet add at least 100 mm.
Other important dimensions	- worksurface thickness as thin as possible, preferred maximum at front edge 30 mm (see clause 6.1) - width of footrest, preferred at least 700 mm - depth of footrest, preferred 700 mm.
[1] For access to and use of a pedal, add pedal height plus sufficient space according to force demands (see EN 1005-3).	

The layout of workstations shall be designed according to the body size of the target population of operators and shall take into account:

— body size (both static and dynamic, including appropriate clothing and / or personal protective equipment) of adults and people with special needs;

— body size and joints functional range (reach envelope, See Annex B.3 and ISO 9241-400);

— safety distances see EN ISO 13857;

— access sizes (for use, installation, adjustment, maintenance, cleaning, repair and transport).

To avoid constraining postures or movements, it is necessary that the size of workstations is compatible with the different operators. This may involve the implementation of adjustment means for each operator to optimize the working positions.

The design shall respect the following principles:

a) the height of use, or other functional dimension of the equipment, shall be adapted to the operator and the type of work to be done, for example by being adjustable;

b) the type, location and seat adjustment possibilities shall be appropriate to the body size of the operator and tasks that are performed;

c) sufficient space shall be provided for all parts of the body to allow for postures and movements necessary to perform the task and to facilitate access and postural changes;

d) the handles and pedals of the machine shall be adapted to the functional anatomy of the hand or foot and population sizes of operators. Handles of hand-held equipment shall be designed to ensure that the operator is able to correctly hold the equipment, adopt good posture and perform the expected movement;

e) control devices which are used frequently or are important (e.g. emergency controls) shall be readily accessible and within the immediate reach of the operator when in the normal working posture. while less frequently used controls must be within the reach envelope of the operator.

When designing a machine to be adapted to an estimated population of operators the 5th to 95th percentile range of dimensions shall be met, at minimum. Where health and safety conditions and other relevant demands or hazards require it, the breadth can range from the 1st to the 99th percentile accommodation for women and men. When determining free spaces (dimensions of space for the legs, for example), one should use the values of the 95th percentile or more for men. For reaching distance, one should use the values of the 5th percentile or less for women. When work equipment sizes are adjustable, the allowable range should cover the 5th to 95th percentile of the population including men and women.

NOTE The standards ISO 15534-1 & 2 provide more complete information on using anthropometric data in designing workspaces.

EN ISO 15537 provides principles for selecting and using test persons for testing anthropometric aspects of industrial products and designs

7 Sitting

Sitting shall not be the only work posture accessible to the worker. The operator shall be provided with the opportunity to change positions throughout the work shift.

Prolonged sitting posture can be stressful and can cause muscle and joint discomfort. Changing position is an important recommendation for also sitting posture.

The advantages of the sitting posture include:

— the physiological energy cost and fatigue are reduced,