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Basic human body measurements for technological design —

Part 4: Expected performance of skilled anthropometrists

DTRFDIS stage

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CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
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Foreword

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This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 3, *Anthropometry and biomechanics*.

A list of all parts in the ISO 7250 series can be found on the ISO website.

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Introduction

Anthropometric data used for technological design have been included in many ISO product standards. There are several standards such as ISO 15535 that refer to a skilled or experienced anthropometrist, but give no clear information on what is a skilled or experienced anthropometrist. The skill of an anthropometrist formforms the most important part of quality control of anthropometric data. The information provided by this technical report complementdocument complements the lack of existing standards and maycan help developers and users of anthropometric databases.

Basic human body measurements for technological design —

Part 4:
Expected performance of skilled anthropometrists

1 Scope

This ~~part of ISO 7250~~document describes the knowledge and ~~skills~~skill required for an experienced anthropometrist who serves as a measurer in anthropometric surveys or a planner of an anthropometric survey. This ~~part of ISO 7250~~document also describes methods to quantify the skill of anthropometrists and to report their performance.

This document is not a textbook or manual for anthropometry but ~~may~~can be useful for those who plan and conduct anthropometric surveys as well as designers and technologists who utilize anthropometric data. Methods described in this document ~~may~~can also be applicable to measurements other than those described in ISO 7250-1.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

— ISO Online browsing platform: available at ~~https://www.iso.org/obp~~https://www.iso.org/obp

— IEC Electropedia: available at ~~https://www.electropedia.org/~~https://www.electropedia.org/

3.1
anthropometrist
person who takes scientifically accurate measurements of the human body according to traditional methods

3.2
inter-observer measurement error
difference between the measurements taken on the same participant by different measurers

3.3
intra-observer measurement error
difference between the repeated measurements taken on the same participant by the same measurer

3.4
anatomical landmark
point clearly defined on the body that can be used for determining anthropometric measurements

[~~Source~~SOURCE: ISO 20685-1:2018, 3.6]

3.5
landmarking
~~placing~~placement of an anatomical landmark point on the skin of a participant by palpating the underlying bone and/or observing the surface shape of anatomical structures

3.6
bias
systematic difference between two sets of measurements on the same participant group by different measurers

4 Background

Different factors influence the quality of anthropometric data by the type of data as shown in ~~Table 1.~~Table 1. In the traditional methods, instruments are simple and easy to calibrate. Body posture is a part of the definition of a measurement item and is controlled by the measurer when taking measurement. Since the time duration required for taking a manual measurement is very short, the influence of the body sway is negligible. Therefore, the skill of the measurer in landmarking and measuring is the main cause of errors in the traditional methods. Reducing errors in landmarking is essential for reducing errors in measurements.

Since the human body is not a rigid object, it is impossible to give the true value to a human body. Therefore, the accuracy of the human body measurement cannot be evaluated. Only the precision of measurement can be evaluated for manual measurements.

Skill of anthropometry can be obtained only through training. The aim of training is to reduce intra- and inter-observer measurement errors. The goal of training is to make a trainee into an experienced anthropometrist. However, self-training that relies solely on textbooks, standards~~,~~ or other material can lead to inaccurate landmarking procedures that result in biased landmark positions. Periodic training with an experienced anthropometrist is necessary.

Scan-derived measurements are influenced by more factors than the 1-D measurements obtained by the traditional methods. The protocol for quality control of scan-derived measurements is already standardized (see ISO 20685-1~~,~~ and ISO 20685-2), except for the protocol for evaluating the performance of software for automatically calculating landmark positions or measurements.

Table 1 — Factors that ~~may~~can influence the quality of anthropometric data

Factor		Traditional body measurement	Scan-derived measurements		
			Body measurement	Landmark coordinate	Surface shape
Tool	Hardware	Accuracy of instrument	N/A		
		N/A	Accuracy of scanner system hardware		
	Software	N/A	Performance of scanner system software (e.g.~~,~~ data merging)		
			Performance of landmarking software		N/A
			Performance of measurement calculation software	N/A	
Human	Measurer	Skill of landmarking			N/A
		Skill of measurement	N/A		
	Operator	N/A	Skill of deciding landmark position from a marker		N/A
		N/A	Skill of operating measurement calculation software	N/A	
	Participant	Repeatability of the posture			
		N/A	Body sway during scan		

~~6~~5 Knowledge expected for experienced anthropometrists

~~6.1~~5.1 General

Experienced anthropometrists are expected to be able to measure measurements of ISO 7250-1 with small intra-observer measurement errors, to obtain reliable statistics from the measured data, and to plan an anthropometric survey. Measuring, obtaining statistics~~,~~ and planning an anthropometric survey require different types of knowledge. They are listed in the following clauses.

~~6.2~~5.2 Landmarking and measurement

The knowledge required for landmarking and measurement includes definitions of landmarks, procedure to decide positions of landmarks and place the landmarks, how to use and care for instruments, definitions of measurement items, and procedure to take measurements. They are listed in the following clauses. More information is available from published textbooks on anthropometry, manual for a survey, or standards.

~~6.2.1~~5.2.1 ~~5.2.1~~ Basic knowledge on human anatomy

Basic knowledge on human anatomy is necessary for understanding the definition of landmarks and their positions in the human body. Some landmarks are defined on a specific position on a bone (e.g. spinous process), and some measurements are defined using names of a specific position of a bone (e.g. styloid process).

Some landmarks defined on the tip of a bone are easier to palpate when the participant bends a joint. However, the participant is in the posture for measurement when the measurer puts a mark on the skin. This is because when the joint bends, the skin slides on the bone, and the relative position of the bone and skin changes.

~~6.2.3~~5.2.2 ~~5.2.2~~ Correct posture of participant

Participant posture is part of the definition of a measurement. Correct posture is essential because when the posture changes, the size of a dimension can also change. For example, shoulder (biacromial) breadth becomes smaller when arms are abducted; foot dimensions are smaller when participant is sitting rather than standing; waist circumference is smaller when the abdominal muscles are tight; stature becomes smaller when participant is not standing erect or larger when participant is in supine position.

The measurer needs to understand the definition of posture and to instruct the participant properly for him~~/~~ or her to take the correct posture.

~~6.2.4~~5.2.3 ~~5.2.3~~ Landmarking

When plural measurements defined using the same landmark are measured, position of the landmark is marked on the skin so that the same location is used for all measurements. An easily removable and non-toxic marker is used. An eyeliner pencil is often used for this purpose. The size and shape of the mark are such that it is easily recognized as a point on the skin, and clearly different from moles.

~~6.2.5~~5.2.4 ~~5.2.4~~ Instruments and small articles

Instruments used are listed in ISO 7250-1~~:2017~~. Small articles used for defining lines or landmarks used in the apparel are listed in ISO 8559-1:2017, 4.2.

Safety of the participant is the matter of first priority. Measurer needs to take care of the pointed tip of the arm of anthropometer or sliding calipers.

Two arms of a large sliding caliper need to be the same length when it is used to measure a point-to-point distance.

Measurer covers the tips of a spreading caliper with fingertips to control the pressure on the participant skin.

Always use flat-tip-jaws of a sliding caliper. Never use pointed-tip-jaws for measuring people.

When a tape measure is wrapped around the participant, the zero point of the tape measure overlaps the scale on the tape measure ~~(Figure 1, A).~~[see Figure 1, a)]. Since the circumference of the trunk influenced by breathing, the participant is naturally breathing when measured.

When a body scanner is used for obtaining body dimensions, the accuracy of scan-derived body dimensions needs to be evaluated according to the protocol described in ISO 20685-1:2018, Clause 5.

a) Proper b) Not proper

Figure 1 — How to wrap a tape measure around participant~~.~~

~~6.2.6~~5.2.5 ~~5.2.5~~ Role of the assistant

~~Measurer~~The measurer and the assistant work together as a team. ~~Assistant~~The assistant helps the measurer in many ways as described below. ~~Measurer~~The measurer needs to give proper instructions to the assistant to get effective help from the assistant.