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Size designation of clothes —

Part 3:
Methodology for the creation of body measurement tables and intervals

Désignation des tailles des vêtements —

Partie 3: Méthodologie de création de barèmes de mensuration du corps et des intervalles

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Foreword

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This document was prepared by Technical Committee ISO/TC 133, *Clothing sizing system — size designation, size measurement methods and digital fittings.*

A list of all parts in the ISO 8559 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In order to size mass-produced clothes, the body size of the intended wearer has to be defined and identified with the nearest size on a table of sizes. In this garment-related system, the body size is defined by scales of the appropriate primary dimensions. A good degree of standardization is achieved by the establishment of open-ended size scales with (fixed or not) intervals in at least the primary control dimension for each garment type. Where body shape is characterized by two primary girth dimensions, the first is placed on fixed scale, while the second (the dependent variable) is not.

The processing of body measurement data as described in this document results in the grouping of body sizes appropriate to the studied population concerned. Examples of garment size tables are readily compiled from this information.

The frequency distribution of body sizes is a useful means of determining which body sizes are applicable to the bulk of the population. Consequently, systems can be adjusted, particularly in the case of waist girth for women's wear for which body shape is defined by dimensions other than the waist girth.

Distribution of body dimensions can change due to changes over time. However, it might not be necessary to update a size table if the products can accommodate the population. As the results of the sizing surveys of the different countries vary, the tables in this document provide the required flexibility.

As an application of the methodology, measurement tables, in conjunction with body shapes, can be used to produce fit mannequins (known as "dummies").

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Size designation of clothes —

Part 3:
Methodology for the creation of body measurement tables and intervals

1   Scope

This document describes the principles of the establishment of tables for body measurements, defines the categories of tables (related to intervals), and lists the population groups (infants, girls, boys, children, women, men) and sub-groups to be used for developing ready-to-wear garments. The body measurement tables and intervals are mainly used by the clothing sector to make the development of well-fitting products easier and more accurate.

The described methodology is mainly based on the application of statistical analysis, using body dimension data. The statistical level has deliberately been kept to a low level in order for the content to be made readily comprehensible to the widest possible readership.

This methodology is applicable to various sets of body dimensions. It can be useful to determine intervals for the size designation as described in ISO 8559-2. Values in the tables in this document are examples.

Garment dimensions are not included in this document.

It is necessary to use a general approach providing inbuilt flexibility in order to keep the whole sizing system capable of adapting to changes (e.g. demographic criteria), because body shape and proportions for any one targeted population group differ significantly.

NOTE   ISO 15535 can be convenient for recording and organizing the population data.

2   Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8559-1, *Size designation of clothes — Part 1: Anthropometric definitions for body measurement*

ISO 8559-2, *Size designation of clothes — Part 2: Primary and secondary dimension indicators*

3   Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8559-1 and ISO 8559-2 and the following apply.

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

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

—   IEC Electropedia: available at http://www.electropedia.org/

3.1
explanatory variable
input data that is used to calculate simple or multiple linear regression

3.2
dependent variable
input data that is used to calculate simple or multiple linear regression, with *explanatory variable(s)* (3.1)

3.3
interval
difference between the two adjoining values in a body measurement table

3.4
drop
<men> half difference between chest girth and waist girth, expressed in centimetres, with a negative value when the chest is smaller than the waist

4 Principles related to the methodology of the creation of the body measurement tables

4.1 General

In order to get a garment fitting correctly on a body, it is essential to collect the body dimension measurements. These measurements are useful to design the 2-dimensional garment pattern, which are to be assembled in garment production. These measurements are useful also to design the 3-dimensional garment, such as seamless knitted garments.

Within the clothing industry, when faced with the need to mass produce clothing articles intended to fit a population of varying morphologies, a series of body measurement tables are internally determined in order to design the appropriate clothing articles. The creation of body measurement tables is based on a statistical approach of the body dimensions of the population.

The producer/retailer strategy, taking into account its market location, its targeted population, etc. leads to the creation of its own body measurement tables. Nonetheless, whatever the basis of the body measurement tables, their creation is based on the same principles as described in this document.

Any regression formula calculated for one group of population is specifically applicable to this group and should not automatically be applied to other groups.

Annex A gives an overview of the clothing industry needs regarding the anthropometric data.

Annex B shows an example of a body measurement table content.

Annex D gives an overview of key statistical tasks.

4.2 Selection of the explanatory variables and the dependent variable (statistical methodology)

The explanatory variable refers to the selected variable input data in the measurement tables. They are mainly based on a dimension characterizing a body measurement (as defined in ISO 8559-1) or based on other body characteristics (e.g. body mass).

Annex C describes statistical models commonly used for the creation of body measurement tables.

The selection of the explanatory variable is based on various criteria:

— the two or more selected explanatory variables, representing body dimensions, shall be statistically independent and perpendicular: one representing the measurement on the vertical axis and the others that of width or girth (on the horizontal axis);

— a robust correlation does exist between the explanatory and dependent variables;

— based on the given ranges and/or intervals related to the development of clothing, the number of sizes is led by the combination of the chosen dimensions;

— the values of the measurements are easy to remember by the consumer.

The selection of the explanatory variables shall be carried out through various statistical studies, with the successive addition of dimensions to the statistical model. This allows the best combination of the dimensions for the explanatory variables and the dependent variable to be obtained.

It is important to take into consideration the following questions while selecting the explanatory and dependent variables in order to design and develop clothing that fits as many target consumers as possible.

a) What are the standard deviations of the dimensions selected as the dependent variable in relation with the dimension(s) selected as the explanatory variables?

b) What should be the relation between the standard deviations mentioned in a) and the tolerance of clothing fitting?

The selection of explanatory variable is usually from the few most important dimensions, such as height, chest girth, waist girth, hip girth.

And then multiple regressions lead to calculate a residual standard deviation, which provides information not explained by the combination of explanatory variable on the prediction of dependent variable. Lower is the residual standard deviation; more satisfactory is the combination of the main dimensions regarding the prediction of the related dependent variable. The residual standard deviation is comparable with the clothing fitting tolerances. The point is that the residual standard deviation leads to calculate a difference allowing for a measured value data, i.e. 95 % of concerned people at this value are placed in this difference, to be compared with the tolerances.

The dependent variable refers to the selected variable input data in the measurement tables that can be used with the explanatory variable. They are mainly based on a dimension characterizing a body measurement (as defined in ISO 8559-1).

The concept of the residual standard deviation, as mentioned in this sub-clause, is suitable for the dependent variable.

5   Categories of body measurement tables

5.1   "Statistic" tables

The creation of the body measurement tables, according to the principles as described in Clause 4 leads to obtaining tables which may be qualified as "statistic" tables.

The tabled dimensions, expressed in centimetres, are generally predicted data, which cannot be suitable for the clothing development. They are not adapted to the design process for ready to wear clothing industry (such as pattern creation, design software). In these tables, intervals are variable.

The content of a body measurement table is based on the explanatory variable, expressed as a body dimension (as defined in ISO 8559-1) and the series of the predicted dependent variable expressed as a body dimension (as defined in ISO 8559-1), see example in Annex B.

5.2   "Linearly smoothed" tables

Only processed data in the form of tables are used for the clothing development.

The first level is to linearly smooth the data to be adapted, for example, to the design software [Computer Assisted Design (CAD)], based on the choice of the value of the step. It means that in these tables, the interval within a sub-group is even. This action leads to "smoothed" tables (see example in Table 1).

Table 1 — Example of linear smoothing of data

	Sub-group 1					Sub-group 2				Sub-group 3	
	inter-val	size #1	size #2	size #3	size #4	interval	size #5	size #6	size #7	interval	size #8
waist girth (cm)	*variable*	50,0	51,5	54,2	56,0	*variable*	58,5	60,5	62,0	*variable*	65,0
	⇩		after linear smoothing			⇩				⇩	
waist girth (cm)	**2,0**	50,0	52,0	54,0	56,0	**2,5**	58,5	61,0	63,0	**3,0**	66,0

6 Choice of the data

6.1 General

In general, as mentioned in 4.2, the choice of the two independent explanatory variables is based on:

— as the length data: height, and

— as the circumference data: chest/bust girth, or waist girth, or hip girth.

Nonetheless the choice of two independent explanatory variables can be different in relation to the type of garment.

For example, in the case of trousers for men, the choice of the two-independent data can be inside leg length (as length data) and waist girth (as circumference data).

6.2 Homogeneous population: improvement in relation to sub-groups of the population

6.2.1 General

From measurement of a population, several groups can be defined so that each group is relatively homogeneous in morphology, in order to get more accurate and reliably predictable system and ensure a better match between the body measurement scales and the clothing fitting.

In order to get a more homogeneous population, additional statistical calculations are carried out to improve the value of R^2, i.e. closer and closer to the value 1.

NOTE 1   A value of R^2 greater than 0,8 is found to be satisfactory.

These additional statistical calculations are based on the determination of sub-groups, which can be based, for example, on the gender, body shape characteristics (e.g. drop values), height, body mass and age.

NOTE 2   Body Mass Index (BMI), which combines the body mass and height (body mass divided by height squared), is sometimes used to determine a sub-group.

NOTE 3   For infants, children, girls and boys, a sub-group based on "age" leads to too large a variation and therefore such a sub-group is not sufficiently homogeneous.

Explanatory variables mentioned in the following subclauses are examples of those commonly used for the creation of body measurement tables. When two explanatory variables are mentioned, the first variable represents the measure on the vertical axis and the second represents the measure on the horizontal axis (girth or width).

6.2.2   "Infants" group

Explanatory variables are height and waist girth.

Sleep bag: Explanatory variables are height and head girth.

Sub-group: mass.

6.2.3   "Children" group (girls and boys)

Explanatory variables are height and hip girth.

Sub-group: based on morphology (e.g. waist girth, BMI).

6.2.4   "Girls" group

Explanatory variables are:

— height and hip girth;

— height and bust girth.

6.2.5   "Boys" group

Explanatory variables are:

— height and waist girth;

— height and chest girth.

6.2.6   "Women" group

To fit the upper body, explanatory variables are height and bust girth.

To fit the lower body, explanatory variables are height, hip girth or waist girth.

For bras, explanatory variables are:

— height and under-bust girth;

— height and bust girth.

Sub-group: based on morphology (e.g. ratio between bust girth, waist girth and hip girth).

6.2.7   "Men" group

To fit the upper body, the usual selected explanatory variables are "height" and "chest girth" (see example in Annex B).

Especially for shirts, the selected explanatory variables can be "arm length" and "neck girth".

To fit the lower body, the usual selected explanatory variables are "height" and "waist girth".

The "men" sub-groups can be based on body shapes, known as "drop". The following drop values are commonly used:

a)   Drop 16 to 10

b)   Drop 8 to 6

c)   Drop 4 to 2