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General requirements for establishing anthropometric databases

Exigences générales pour la création de bases de données anthropométriques

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Contents

Page

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 2.

The main task of technical committees is to prepare International Standards. 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 the member bodies casting a vote.

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

ISO 15535 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 3, *Anthropometry and biomechanics*.

This third edition cancels and replaces the second edition (ISO 15535:2006), of which it constitutes a minor revision. Among other modifications, Annex I has been added to improve clarity.

Introduction

The well-being of people is very much dependent on their proportional and geometric relationship with several factors, such as growth, design principles for clothing, transportation, workplace and homes, as well as sporting and recreational activities. Implementation of databases on body dimensions of a population supports essential health and safety requirements, as well as International Standards in the field of machinery safety and personal protective equipment, and has acquired importance in the devising of computer-generated manikins of the human body.

One of the major difficulties in formulating international databases on anthropometry is that the numerous existing studies are rarely comparable in the strictest sense. Difficulties arise in comparing one study with another because either the methods used differ or they are not sufficiently well described. The anthropometric standards used for the data collection are fundamental to setting up any anthropometric databases.

This International Standard is intended to be used in close conjunction with ISO 7250-1. The ultimate goal is that a database developed by one researcher could be easily used by other researchers. This would be in a form that is readily accessible by those responsible for developing standards in support of good design and health and safety requirements (e.g. ISO 15534 and ISO 14738). To achieve this goal, it has been necessary to develop an appropriate International Standard to ensure that anthropometric databases and their associated reports are internationally compatible.

General requirements for establishing anthropometric databases

1 Scope

This International Standard 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 this International Standard are people who are able to hold the postures specified in ISO 7250-1.

NOTE The traditional anthropometry defined in ISO 7250-1 is considered to be a necessary complement to 3-D methods which are being developed in some countries. It is important that scanned data are verified according to the definitions given in ISO 7250-1 (see ISO 20685). State-of-the-art software allows integration of traditional anthropometric measures with those obtained by 3-D imaging.

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 any amendments) applies.

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

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

ISO 8601, *Data elements and interchange formats — Information interchange — Representation of dates and times*

ISO/IEC 8859-1, *Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*

3 Terms and definitions

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

3.1
population segment
group of people having one or more common background characteristics that influence their anthropometric distributions

3.2
user population
population segment or segments for whom a technological design is intended

3.3
random sample
sample established by following a set of procedures to ensure that each and every individual in the population has an equal chance of being selected

3.4
stratified sample
sample established by a procedure in which the population is divided into sub-populations (strata), each one of which contributes with a specified number of randomly selected individuals

3.5
demographic data
background information (such as sex, dwelling or working place, occupation, education) used to describe members of the user population and/or population segments

3.6
anthropometry
study and measurement of the physical dimensions and mass of the human body and its constituent (external) parts

Note 1 to entry: Taken from the Greek word *anthropos* (human being or Man) and *metron*, to measure.

3.7
anthropometric data
dimensional measurements (such as heights, lengths, depths, breadths and circumferences) of the human body and its component parts

3.8
anthropometric database
collection of individual body measurements (anthropometric data) and background information (demographic data) recorded on a group of people (the sample)

3.9
anthropometric report
technical report describing the origin, contents, methods, and statistical characteristics of an anthropometric database

4 Data collection design

4.1 General

The following methods shall be used in assembling internationally compatible anthropometric databases.

4.2 Definitions, techniques and conditions of measurement

4.2.1 The measuring methods given in ISO 7250-1 shall be used. Any deviation from this shall be indicated in the anthropometric report. It is anticipated that items other than those specified in ISO 7250-1 will be measured according to the purpose of the investigation. In such cases, definitions, methods, instruments and measurement units shall be clearly indicated in the report.

4.2.2 When a measurement can be taken on both the left and right sides of the human body, the report shall clearly indicate on which side the measurement has been taken.

4.2.3 Photographs or detailed sketches of the measurements taken should be provided and the measurement procedures should be documented.

4.2.4 The subject shall be nude or wearing minimal clothing, shall be bareheaded and without shoes. The type of clothing, if relevant, shall be coded on the anthropometric data sheet.

4.2.5 The measurement conditions shall be documented, together with the numerical results of any survey.

4.3 Sampling techniques

4.3.1 The demographic characteristics of the population shall be indicated as clearly as possible in the report. In the event that the population is divided into several subgroups, e.g. exam location and dwelling location for either sampling or statistical reporting, this shall be stated in the report.

4.3.2 It is desirable that random or stratified random sampling methods be used. However, if this is impossible, the report shall indicate the sampling method used.

4.3.3 It is desirable that the number of subjects needed for a database be established using a statistical power formula based on the accuracy of results desired by the investigator (see Annex A). However, in reality, the selection of subjects is often influenced by various factors, such as population size, number of people who agree to participate, and cost and period of time required for the investigation.

5 Data collection requirements

5.1 Basic demographic description of subjects

Biographic questionnaires shall be filled out to provide information that includes sex, date of birth, date of examination, and exam location. Other demographic information may be included on the questionnaire depending upon the purposes of the study.

5.2 Detection and treatment of measurement errors

The editing of obvious anomalies during data collection should be carried out using, for example, computer software specifically written for the purpose of detecting figures that lie outside any reasonable range of data given for that dimension (see Annex F).

5.3 Instrument accuracy

Anthropometric instruments for taking linear and circumferential measures shall measure to the nearest millimetre. Instruments for measuring body mass shall weigh to the nearest 500 g.

5.4 Sample composition

The following shall always be taken into account during planning of data collection:

— age;

— sex.

5.5 Sample size

The sample size shall be sufficient to estimate the value of the given measurement in a specified group. For example, the sample size should be sufficient to estimate the true population mean of stature within ± 10 mm for women who are between 30 years and 34 years of age. A method for calculating sample size is presented in Annex A.

Where appropriate for a particular study, the following may also be taken into account for sample size determination:

— geographical location;

— socio-economic status;

— educational level;

— occupation;

— other demographic variables that influence anthropometric distributions.

5.6 Data-storage system

All biographical and subject data should be recorded on digital media compatible with widespread digital systems, whenever possible.

5.7 Type of clothing

The type of clothing shall be coded and identified (e.g. nude = 0, underwear = 1, light clothing = 2, other clothing as specified = 3) for analysis purposes.

5.8 Measurer training and quality control

Frequent and regular measurer training and quality control shall be carried out by persons experienced in anthropometry, in order to ensure acceptable standards of accuracy. Repeated measurement data should be recorded. Inter- and intra-measurer standard error of measurement, or mean absolute difference, shall be calculated and recorded for all anthropometric variables, in order that random checks can be carried out on the measuring teams during the survey.

6 Database format

6.1 The ASCII code, according to ISO/IEC 8859-1, shall be used. For analytical purposes, other data storage formats may be used in addition to ASCII.

6.2 Each data item shall be separated by a tab.

6.3 The contents of rows in the database are given in 6.3.1 to 6.3.3.

6.3.1 The data shall be entered in English.

6.3.2 The name of each data item shall be shown in the first row of the database using the designated English words and appropriate labels in other language(s), if needed. Item code numbers and acronyms should not be used in row 1 instead of English names, as they may cause confusion.

6.3.3 The second and subsequent rows of the database shall contain actual data from subjects with each data item in the same order as its name is listed in row 1.

EXAMPLE

Subject number	Sex	Exam location	Exam date	…	Body mass	Stature	…
0001	M	GB/London	2000-05-23	…	78,5	1756	…

6.4 All body measurements shall be recorded in millimetres (mm) or kilograms (kg) (SI units).

6.5 Missing data shall be recorded as 9999.

6.6 An example of database format from an anthropometric survey using the sample data sheet (Annex C) is presented in Annex I. The example shows the format of a database when some, but not all, dimensions according to ISO 7250-1 are measured.

7 Database contents

The following data items shall be included in the database.

7.1 Required background data

7.1.1 Item 1 Subject number.

7.1.2 Item 2 Sex: M for male subjects, F for female subjects.

7.1.3 Item 3 Exam location: country, ISO 3166-1 and location.

7.1.4 Item 4 Exam date: ISO 8601 method yyyy-mm-dd (for example, 2003-05-23 for 23rd of May, 2003).

7.1.5 Item 5 Birth date: ISO 8601 method yyyy-mm-dd (for example, 2003-04-05 for 5th of April, 2003).

7.1.6 Item 6 Decimal age: subject's age calculated after the exam in accordance with the method described in Annex D.

7.2 Recommended background data

Additional background data items such as birthplace, school, occupation or population segment may also be included, depending upon the purposes of the study.

7.3 Anthropometric data

Anthropometric data, according to ISO 7250-1, shall be recorded as Items 11 to 56. In the event that some variables in ISO 7250-1 are not measured, or if there are missing data, these shall be recorded as 9999.

7.4 Complementary data

In the event that additional body measurements not present in ISO 7250-1 are measured, these data shall be recorded as data items 57 and higher, in alphabetical order.

8 Anthropometric data sheets

Biographical data and measurements of each subject shall be recorded on electronic forms or data sheets (see Annex C).

9 Statistical processing

9.1 Before calculating statistical values, irregular values shall be detected and reviewed (see Annex F).

9.2 The age of each subject shall be calculated by decimal notation (see Annex D).

9.3 In the event that subjects are in the growth period, their measurements shall be tabulated for each one-year age interval, as given in Table E.1.

9.4 It is recommended that the data be tabulated for adult subjects in 5-year divisions (see Annex E). If that is impossible, for example when sample sizes are small, 10-year divisions or 20-year divisions, as given in Table E.2, shall be used. It is desirable to tabulate data for the adult male and adult female samples. If a combined sex sample is also reported, and the sample sizes of male and female data are unequal, the data shall be weighted to account for unequal sample sizes.

9.5 Information on the presentation of data and interpretation of statistics is given in Annex F.

Annex A
(normative)

Method for estimating the number of subjects needed on a sample

The sample size shall be estimated to be sufficient for the purposes of investigation. In most cases, anthropometric data for technological design are of interest at the 5th and 95th percentiles.

The method given below is one way of estimating the sample size required to have a particular confidence at 5th and 95th percentiles.

A.1 The minimum number of randomly sampled subjects, N, needed to ensure that a database 5th and 95th percentile estimates the true population 5th and 95th percentiles with 95 % confidence and a percentage of relative accuracy is calculated using the following formula:

$$N = \left(\frac{1{,}96 \times \mathrm{CV}}{a} \right)^2 \times 1{,}534^2 \tag{A.1}$$

where

1,96 is the critical value (z value) from a standard normal distribution for a 95 % confidence interval;

CV is the coefficient of variation

$$\mathrm{CV} = \frac{\mathrm{SD}}{\bar{x}} \times 100$$

where

$\bar{x}$ is the mean of the population for the body dimension in question;

SD is the standard deviation of the population for the body dimension in question;

a is the percentage of relative accuracy desired.

A.2 The equation for minimum sample size presented in A.1 is derived as follows.

The 95 % confidence interval for a percentile is given by the expression

$$P \pm 1{,}96 \times S_P \tag{A.2}$$

where

P is the percentile estimate;

S_P is the standard error of this percentile.

It is desired that the confidence interval is to be no larger than ± some percentage (a) of the mean. Therefore, a sample size is required sufficient to ensure that

$$1{,}96 \times S_P \leq \frac{a\bar{x}}{100} \tag{A.3}$$

To solve this equation, an expression for S_P is needed — in this case, the standard error for a 5th or 95th percentile:

$$S_P = \sqrt{S_{\bar{x}}^2 + 1{,}645^2 \times S_{s_x}^2} \tag{A.4}$$

where

$S_{\bar{x}}$ is the standard error of the mean;

S_{s_x} is the standard error of the standard deviation.

Formula (A.4) can be simplified, however, because both $S_{\bar{x}}$ and S_{s_x} are functions of s_x, the standard deviation:

$$S_{\bar{x}} = \sqrt{\frac{s_x^2}{n}} \tag{A.5}$$

$$S_{s_x} = \sqrt{\frac{s_x^2}{2n}} \tag{A.6}$$

Therefore, the standard error of a 5th or 95th percentile in Formula (A.4) can be expressed as

$$S_P = \sqrt{\frac{s_x^2}{n} + 1{,}645^2 \times \frac{s_x^2}{2n}} \tag{A.7}$$

And it can be further reduced algebraically as follows:

$$S_P = \frac{s_x}{\sqrt{n}} \sqrt{1 + \frac{1{,}645^2}{2}} = \frac{s_x}{\sqrt{n}} \times 1{,}534 \tag{A.8}$$

Substituting Formula (A.8) into Formula (A.3), we have the following:

$$1{,}96 \times \frac{s_x}{\sqrt{n}} \times 1{,}534 \leq \frac{a\bar{x}}{100} \tag{A.9}$$

And, rearranging algebraically, we have

$$1{,}96 \times \frac{100 s_x}{a\bar{x}} \times 1{,}534 \leq \sqrt{n} \tag{A.10}$$

However, the coefficient of variation is defined as follows:

$$\mathrm{CV} = \frac{s_x}{\bar{x}} \times 100 \tag{A.11}$$

Therefore, Formula (A.10) can be further reduced to

$$1{,}96\times\frac{\mathrm{CV}}{a}\times 1{,}534 \le \sqrt{n} \tag{A.12}$$

And solved for n:

$$n \ge \left(1{,}96\times\frac{\mathrm{CV}}{a}\right)^2 \times 1{,}534^2$$

$$n \ge \left(3{,}006\times\frac{\mathrm{CV}}{a}\right)^2 \tag{A.13}$$

A.3 In practice, the true mean and standard deviation of the population are usually unknown, so these values are estimated by using the results of a previous study on a similar population.

A.4 Because each body dimension in a study will have a different coefficient of variation (CV), each will require a slightly different minimum sample size to ensure that its percentile value will estimate the population 5th and 95th percentiles with a certain percentage precision and 95 % confidence. In practice, however, it is desirable to calculate the minimum sample size for a study using the body dimension having the largest CV. When this approach is taken, the calculated sample size will be sufficient for a certain percentage of relative accuracy and 95 % confidence in the worst case, and it will be more than sufficient for all the other body dimensions.

A.5 For example, suppose an investigator wishes the study sample to approximate that true population 5th and 95th percentiles of stature, chest circumference and shoulder (bideltoid) breadth, with at least 1 % relative accuracy and 95 % confidence. A previous study of the same or similar population resulted in the following sample statistics:

	Mean	SD	CV
Stature	175,6	6,7	3,8
Chest circumference	99,1	6,9	7,0
Shoulder (bideltoid) breadth	49,2	2,6	5,3

Entering these data into Formula (A.1), the sample sizes in Table A.1 are calculated.

Table A.1 — Minimum sample size for 95 % confidence and 1 % relative accuracy

Stature	$N=\left(1{,}96\times\frac{3{,}8}{1}\right)^2\times(1{,}534)^2=130{,}5=131$ subjects
Chest circumference	$N=\left(1{,}96\times\frac{7{,}0}{1}\right)^2\times(1{,}534)^2=443{,}0=443$ subjects
Shoulder (bideltoid) breadth	$N=\left(1{,}96\times\frac{5{,}3}{1}\right)^2\times(1{,}534)^2=253{,}9=254$ subjects

As can be seen from Table A.1, by measuring 443 subjects, the investigator ensures that the desired levels of relative accuracy and confidence are achieved for all the variables.

Annex B
(normative)

Anthropometric data sheet

B.1 Introduction

At the minimum, the following basic items shall be present on the anthropometric data sheet of each subject. Other demographic variables of importance to the study should also be recorded on this data sheet.

B.1.1 Subject identification

Each subject's data sheet shall have an arbitrary or randomly assigned identification number and/or the subject's name. It is strongly recommended that both be used during data collection so that subjects may be addressed respectfully by name, and to ensure that assigned identification numbers are unique to each subject. However, after data collection is completed, the anthropometric database shall be rendered anonymous and retained in a form in which personal identification of the subject is no longer possible.

B.1.2 Sex

The subject's sex shall be recorded.

B.1.3 Exam location

The region and/or country shall be recorded.

B.1.4 Exam date

It shall be recorded as Year-Month-Day.

B.1.5 Birth date

It shall be recorded as Year-Month-Day.

B.1.6 Measurement items

Measurement items from ISO 7250-1 should appear as the first measurement items on the data sheet. According to the purpose of the investigation, the measurement items which are provided by any International Standard other than ISO 7250-1 may be added. In that case, definitions, measuring methods, instruments, etc. shall be indicated at the beginning of the accompanying report.

B.1.7 Name of the measurer

Name of the measurer(s) who is (are) measuring the subject. This information is helpful during data collection and whenever questions about unusual values arise. However, there is no need to include this information as a data item in the final version of the database.

Annex C
(informative)

Example of anthropometric data sheet

C.1 Personal identifying information

Personal data that can be used to identify individual subjects (e.g. their names) are protected by privacy laws in many ISO member nations (see B.1.1). To address privacy requirements, it is recommended that names are recorded with their corresponding arbitrary subject numbers in a file that is kept separately from the anthropometric database itself, and access to this file is governed by the individual nation's privacy laws. In this case, original data sheets which associate names and other identifying information with anthropometric data are destroyed once the digital database has been created.

C.2 Order of measurement variables

In the example shown in Table C.1, measurement variables are arranged according to the anthropometric instrument in use at the time. It should be noted that this arrangement is different from the one used for storing data in the database.

Efficiency at the workplace should take precedence over database considerations when arranging the anthropometric data sheet.

C.3 Memorandum from the measurer(s)

Space on the measurement sheet is left for the measurer to note anything unusual about the subject that could be helpful during data analysis and interpretation. If the subject is extremely large/small or asymmetrical, for example, this is noted and used to corroborate the validity of that subject's unusual values during the pre-processing data review.

Table C.1 — Example of anthropometric data sheet, where numbering after dimensions refers to corresponding subclauses of ISO 7250-1

Subject No.: Sex: M F Exam location:					
Exam date: yyyy-mm-dd Birth date: yyyy-mm-dd					
Decimal age: yy.xxx					
Firm/affiliation: Section:					
School: basic/secondary/high/university (grade: class:) (School name:)					
Type of clothing: 0 1 2 3 Occupation:					
1. Weight	4.1.1	kg	11. Chest circumference	4.4.9	mm
2. Stature	4.1.2	mm	12. Waist circumference	4.4.10	mm
3. Iliac spine height, standing	4.1.6	mm	13. Thigh circumference	4.4.12	mm
4. Fist (grip axis) height	4.4.4	mm	14. Calf circumference	4.4.13	mm
5. Knee height	4.2.14	mm	15. Sagittal arc	4.3.13	mm
6. Shoulder (biacromial) breadth	4.2.8	mm	16. Head length	4.3.9	mm
7. Chest breadth, standing	4.1.11	mm	17. Head breadth	4.3.10	mm
8. Hip breadth, standing	4.1.12	mm	18. Hand length	4.3.1	mm
9. Hip breadth, sitting	4.2.11	mm	19. Foot length	4.3.7	mm
10. Abdominal depth, sitting	4.2.15	mm	20. Foot breadth	4.3.8	mm
Memorandum: Measurer(s):					

Annex D
(informative)

Method of calculating decimal-notation date and age

D.1 Manual method of calculating decimal age

Months	January	February	March	April	May	June	July	August	September	October	November	December
Days	1	2	3	4	5	6	7	8	9	10	11	12
1	000	085	162	247	329	414	496	581	666	748	833	915
2	003	088	164	249	332	416	499	584	668	751	836	918
3	005	090	167	252	334	419	501	586	671	753	838	921
4	008	093	170	255	337	422	504	589	674	756	841	923
5	011	096	173	258	340	425	507	592	677	759	844	926
6	014	099	175	260	342	427	510	595	679	762	847	929
7	016	101	178	263	345	430	512	597	682	764	849	932
8	019	104	181	266	348	433	515	600	685	767	852	934
9	022	107	184	268	351	436	518	603	688	770	855	937
10	025	110	186	271	353	438	521	605	690	773	858	940
11	027	112	189	274	356	441	523	608	693	775	860	942
12	030	115	192	277	359	444	526	611	696	778	863	945
13	033	118	195	279	362	447	529	614	699	781	866	948
14	036	121	197	282	364	449	532	616	701	784	868	951
15	038	123	200	285	367	452	534	619	704	786	871	953
16	041	126	203	288	370	455	537	622	707	789	874	956
17	044	129	205	290	373	458	540	625	710	792	877	959
18	047	132	208	293	375	460	542	627	712	795	879	962
19	049	134	211	296	378	463	545	630	715	797	882	964
20	052	137	214	299	381	466	548	633	718	800	885	967
21	055	140	216	301	384	468	551	636	721	803	888	970
22	058	142	219	304	386	471	553	638	723	805	890	973
23	060	145	222	307	389	474	556	641	726	808	893	975
24	063	148	225	310	392	477	559	644	729	811	896	978
25	066	151	227	312	395	479	562	647	731	814	899	981
26	068	153	230	315	397	482	564	649	734	816	901	984
27	071	156	233	318	400	485	567	652	737	819	904	986
28	074	159	236	321	403	488	570	655	740	822	907	989
29	077	159	238	323	405	490	573	658	742	825	910	992
30	079	—	241	326	408	493	575	660	745	827	912	995
31	082	—	244	—	411	—	578	663	—	830	—	997
Months	January	February	March	April	May	June	July	August	September	October	November	December
Days	1	2	3	4	5	6	7	8	9	10	11	12

EXAMPLE The 14th day of October is found in the column of October and its 14th line, as 784. Therefore, the examination date 2002-10-14 is shown as 2 002,784, and the birth date 1981-06-17 is shown as 1 981,458, so the decimal age at the examination date is calculated as 2 002,784 – 1 981,458 = 21,33 (rounded off to two decimal places).

D.2 Program for computer

```
Function agecalc(examyear, exammonth, examdate, birthyear, birthmonth, birthdate)
Dim Cexam As Integer: Dim Cbirth As Integer
If exammonth = 1 Then Cexam = 0
If exammonth = 2 Then Cexam = 31
If exammonth = 3 Then Cexam = 59
If exammonth = 4 Then Cexam = 90
If exammonth = 5 Then Cexam = 120
If exammonth = 6 Then Cexam = 151
If exammonth = 7 Then Cexam = 181
If exammonth = 8 Then Cexam = 212
If exammonth = 9 Then Cexam = 243
If exammonth = 10 Then Cexam = 273
If exammonth = 11 Then Cexam = 304
If exammonth = 12 Then Cexam = 334
If birthmonth = 1 Then Cbirth = 0
If birthmonth = 2 Then Cbirth = 31
If birthmonth = 3 Then Cbirth = 59
If birthmonth = 4 Then Cbirth = 90
If birthmonth = 5 Then Cbirth = 120
If birthmonth = 6 Then Cbirth = 151
If birthmonth = 7 Then Cbirth = 181
If birthmonth = 8 Then Cbirth = 212
If birthmonth = 9 Then Cbirth = 243
If birthmonth = 10 Then Cbirth = 273
If birthmonth = 11 Then Cbirth = 304
If birthmonth = 12 Then Cbirth = 334
If birthmonth = 2 And birthdate = 29 Then birthdate = 28 (This means 02-29 is counted as 02-28 for Birthdate)
```

If exammonth = 2 And examdate = 29 Then examdate = 28 (This means 02-29 is counted as 02-28 for Exam date)

$$\text{agecalc} = \text{examyear} - \text{birthyear} + \left(\text{Cexam} + \text{examdate} - \text{Cbirth} - \text{birthdate}\right)/365$$

End Function

NOTE Commercially available software, such as spreadsheets, can be used and can address the problem introduced by leap years.

Annex E
(normative)

Age stratification at specified growth period

The individual ages, calculated by the method given in Annex D, shall be divided into age groups in accordance with Tables E.1 and E.2.

Table E.1 — Method of age division for children and young adults

Age group	5,0	6,0	7,0	8,0	9,0	10,0	11,0	12,0	13,0	14,0	15,0	16,0	17,0	18,0	19,0
Individual age	4,50 to 5,49	5,50 to 6,49	6,50 to 7,49	7,50 to 8,49	8,50 to 9,49	9,50 to 10,49	10,50 to 11,49	11,50 to 12,49	12,50 to 13,49	13,50 to 14,49	14,50 to 15,49	15,50 to 16,49	16,50 to 17,49	17,50 to 18,49	18,50 to 19,49

Table E.2 — Method of age division

5-year division		**10-year division**		**20-year division**		**Adults**	
Age group	**Individual age**	**Age group**	**Individual age**	**Age group**	**Individual age**	**Age group**	**Individual age**
20 to 24	19,50 to 24,49	20 to 29	19,50 to 29,49	20 to 39	19,50 to 39,49	20 and more	older than 19,50
25 to 29	24,50 to 29,49						
30 to 34	29,50 to 34,49	30 to 39	29,50 to 39,49				
35 to 39	34,50 to 39,49						
40 to 44	39,50 to 44,49	40 to 49	39,50 to 49,49	40 to 59	39,50 to 59,49		
45 to 49	44,50 to 49,49						
50 to 54	49,50 to 54,49	50 to 59	49,50 to 59,49				
55 to 59	54,50 to 59,49						
60 to 64	59,50 to 64,49	60 to 69	59,50 to 69,49	60 to 79	59,50 to 79,49		
65 to 69	64,50 to 69,49						
70 to 74	69,50 to 74,49	70 to 79	69,50 to 79,49				
75 to 79	74,50 to 79,49						
80 to 84	79,50 to 84,49	80 to 89	79,50 to 89,49	80 to 99	79,50 to 99,49		
85 to 89	84,50 to 89,49						
90 to 94	89,50 to 94,49	90 to 99	89,50 to 99,49				
95 to 99	94,50 to 99,49						

Annex F
(normative)

Procedure for preparing data and statistics

F.1 Data preparation

F.1.1 First, the mean value and the standard deviation of each age group shall be obtained, and then the subjects' measurement data over ±3 SD from the mean shall be reviewed individually for accuracy.

F.1.2 Second, the scatter diagrams of measurement pairs having a high correlation and those which make practical sense shall be prepared for each age group. Then the subjects shown in the diagram to be outliers shall be investigated. If the cause of the discrepancy is clear, the data shall be corrected if necessary. If the cause is unclear, the data shall be replaced with 9999 to denote missing data.

F.1.3 The data reviewed by these procedures shall form the reference data set. The basic statistical values to be reported shall be obtained from the reference data set.

F.1.4 Some dimensions, like skinfold thicknesses, which are not included in ISO 7250-1 and do not have a Gaussian distribution, should be normalized.

F.2 Data reporting

F.2.1 After completing the pre-processing of the data set, the following descriptive statistics should be presented for each dimension measured:

— number of subjects;

— minimum;

— maximum;

— arithmetic mean;

— standard error of the mean ($S_{\bar{x}}$);

— standard deviation (SD);

— standard error of the 5th and 95th percentiles;

— coefficient of variation;

— frequency distribution;

— skewness;

— kurtosis;

— percentiles, 1st to 99th: the percentile values reported shall be calculated from the actual distribution of individual subjects in the sample rather than estimated from a theoretical Gaussian distribution using the sample mean and standard deviation: 1st, 5th, 10th, 25th, 50th, 75th, 90th, 95th and 99th.

F.2.2 Where individual subject data or raw data are not provided, it is recommended that correlation coefficients (calculated to three decimal places) between variables are provided. Correlation coefficients shall be presented as a matrix.

F.2.3 In statistical tables, English dimension names shall be used. Information specified in Clause 5 shall also be given in English.

Annex G
(informative)

Recommended scientific and technical objectives for setting up internationally compatible databases

G.1 Assess existing data to determine whether critical dimensions are available, and whether the available data are current or out of date.

G.2 If new data are required, determine an appropriate sample size and develop a sampling strategy. For example, an appropriate stratified sample might include strata such as geographic area, age and sex. Considerations should be given to sample acquisition methods, in order to ensure a representative sample in each sample stratum.

G.3 Use the measurement techniques outlined in ISO 7250-1. Ensure that measurers are adequately trained in these techniques.

G.4 Ensure the data quality by collecting inter-measurer and intra-measurer data, and establishing continuing supervision of data collection.

Annex H
(informative)

Application of measurements

The majority of the body measurements and derived measurements will serve to fulfil multiple design and sizing purposes, and will be used in some of the following categories: basic body descriptors, key measurements, garments including personal equipment, clothing manikins, load-carrying systems, head and face equipment, footwear, handwear, workspace and body clearance, vehicle accommodation, biomechanical body links, computer manikins and body templates.

In order to ensure that a design accommodates the intended user population, it is necessary to be able to identify those measurements which are critical for ensuring an adequate match between an individual and the equipment. This may require limited user trials.

The user-population measurements should be readily accessible from the stored database. Because the critical measurements may need to be derived from combinations of measurements that have been taken, the database should allow either the calculation of derived measurements for each surveyed individual relevant to the user population, or a means of incorporating correlation-coefficient information in estimates of derived measures.

Anthropometric-database information can be used for determining the mismatch between a design and a particular population. This may be necessary if restrictions are required for the safe use of a piece of equipment. For example, some fairground rides are only suitable for children, because of size constraints. Where age or stature restrictions are used as a means of risk control, then it is important to be able to relate data on the critical measurement (e.g. sideways reach) to age or stature, so that its effectiveness as a control measure can be ensured.

Sizing tariffs for clothing or equipment can be derived from measurements in the database. This is best done if multi-variable combinations of measurements can be assessed for their ability to accommodate a section of the population.

Annex I
(informative)

Sample database format

subject number	sex	exam location	exam date	birth date	decimal age	firm/affiliation	school	clothing	occupation	4.1.1 Body mass (weight)	4.1.2 Stature (body height)	4.1.3 Eye height	4.1.4 Shoulder height	4.1.5 Elbow height	4.1.6 Iliac spine height, stand	4.1.7 Crotch height	4.1.8 Tibial height	4.1.9 Chest depth, standing	4.1.10 Body depth, standing	4.1.11 Chest breadth, standir	4.1.12 Hip Breadth Standing	4.2.1 Sitting height (erect)	4.2.2 Eye height, sitting	4.2.3 Cervicale height, sitting	4.2.4 Shoulder height, sitting	4.2.5 Elbow height, sitting	4.2.6 Shoulder-elbow length	4.2.7 Elbow-wrist length
1	M	US/NewYork	2010-05-23	1992-02-12	18.27	ATT	3	0	clerk	87,5	1607	9999	9999	9999	965	9999	9999	9999	9999	287	317	9999	9999	9999	9999	9999	9999	9999
2	M	US/NewYork	2010-05-23	1990-04-17	20.1	Goldman	3	0	office work	72,0	1653	9999	9999	9999	1005	9999	9999	9999	9999	302	323	9999	9999	9999	9999	9999	9999	9999
3	F	US/NewYork	2010-05-24	1991-04-05	19.13	Chase	3	0	bank teller	42,5	1696	9999	9999	9999	1030	9999	9999	9999	9999	307	334	9999	9999	9999	9999	9999	9999	9999
4	F	US/NewYork	2010-05-24	1990-02-02	20.3	Picholine	3	0	waiter	50,5	1804	9999	9999	9999	962	9999	9999	9999	9999	322	345	9999	9999	9999	9999	9999	9999	9999
5	M	US/NewYork	2010-05-24	1992-03-03	18.22	9999	3	0	actor	78,0	1744	9999	9999	9999	1134	9999	9999	9999	9999	347	398	9999	9999	9999	9999	9999	9999	9999

Bibliography

[1] ISO 14738, *Safety of machinery — Anthropometric requirements for the design of workstations at machinery*

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[5] ISO 20685, *3-D scanning methodologies for internationally compatible anthropometric databases*

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