IEC 80000-14

Edition 1.0 2008-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Quantities and units –
Part 14: Telebiometrics related to human physiology

Grandeurs et unités –
Partie 14: Télébiométrique relative à la physiologie humaine

IEC 80000-14:2008

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FOREWORD

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International Standard IEC 80000-14 has been prepared by IEC technical committee 25: Quantities and units, and their letter symbols.

The text of this part of IEC 80000 is based on the following documents:

FDIS	Report on voting
25/366/FDIS	25/372/RVD

Full information on the voting for the approval of this part of IEC 80000 can be found in the report on voting indicated in the above table.

This international standard has been prepared in co-operation with ISO/TC 12.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
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IEC 80000 consists of the following parts, under the general title *Quantities and units*:

Part 6*: Electromagnetism*

Part 13*: Information science and technology*

Part 14*: Telebiometrics related to human physiology*

The following parts are published by ISO:

Part 1*: General*

Part 2*: Mathematical signs and symbols for use in the natural sciences and technology*

Part 3*: Space and time*

Part 4*: Mechanics*

Part 5*: Thermodynamics*

Part 7*: Light*

Part 8*: Acoustics*

Part 9*: Physical chemistry and molecular physics*

Part 10*: Atomic and nuclear physics*

Part 11*: Characteristic numbers*

Part 12*: Solid state physics*

0 Introduction

Subclauses 0.1 to 0.5 are text that is common to many Parts of ISO/IEC 80000. Some of this text is not applicable to this Part of ISO/IEC 80000, but is included for consistency with other parts. Subclause 0.6 is specific to this part of ISO/IEC 80000.

0.1 Arrangement of the tables

The tables of quantities and units in ISO/IEC 80000 are arranged so that the quantities are presented on the left-hand pages and the units on the corresponding right-hand pages.

All units between two full lines on the right-hand pages belong to the quantities between the corresponding full lines on the left-hand pages.

Where the numbering of an item has been changed in the revision of a part of ISO 31, the number in the preceding edition is shown in parenthesis on the left-hand page under the new number for the quantity; a dash is used to indicate that the quantity in question did not appear in the preceding edition.

0.2 Tables of quantities

The names in English and in French of the most important quantities within the field of this part of ISO/IEC 80000 are given together with their symbols and, in most cases, definitions. These names and symbols are recommendations. The definitions are given for identification of the quantities in the International System of Quantities (ISQ), listed on the left hand pages of the Tables in this part of ISO/IEC 80000; they are not intended to be complete.

The scalar, vectorial or tensorial character of quantities is pointed out, especially when this is needed for the definitions.

In most cases only one name and only one symbol for the quantity are given; where two or more names or two or more symbols are given for one quantity and no special distinction is made, they are on an equal footing. When two types of italic letters exist (for example as with ϑ and θ; φ and ϕ; *a* and a; *g* and g) only one of these is given. This does not mean that the other is not equally acceptable. It is recommended that such variants should not be given different meanings. A symbol within parenthesis implies that it is a reserve symbol, to be used when, in a particular context, the main symbol is in use with a different meaning.

In this English edition the quantity names in French are printed in an italic font, and are preceded by *fr*. The gender of the French name is indicated by (m) for masculine and (f) for feminine, immediately after the noun in the French name.

0.3 Tables of units

0.3.1 General

The names of units for the corresponding quantities are given together with the international symbols and the definitions. These unit names are language-dependent, but the symbols are international and the same in all languages. For further information, see the SI Brochure (8th edition 2006) from BIPM and ISO 80000-1.

The units are arranged in the following way:

a) The coherent SI units are given first. The SI units have been adopted by the General Conference on Weights and Measures (Conférence Générale des Poids et Mesures, CGPM). The coherent SI units, and their decimal multiples and submultiples formed with the SI prefixes, are recommended, although the decimal multiples and submultiples are not explicitly mentioned.

b) Some non-SI units are then given, being those accepted by the International Committee for Weights and Measures (Comité International des Poids et Mesures, CIPM), or by the International Organization of Legal Metrology (Organisation Internationale de Métrologie Légale, OIML), or by ISO and IEC, for use with the SI. Such units are separated from the SI units in the item by use of a broken line between the SI units and the other units.

c) Non-SI units currently accepted by the CIPM for use with the SI are given in small print (smaller than the text size) in the "Conversion factors and remarks" column.

d) Non-SI units that are not recommended are given only in annexes in some parts of ISO/IEC 80000. These annexes are informative, in the first place for the conversion factors, and are not integral parts of the standard. These deprecated units are arranged in two groups:

   1) units in the CGS system with special names;

   2) units based on the foot, pound, second, and some other related units;

e) Other non-SI units given for information, especially regarding the conversion factors are given in another informative annex.

0.3.2 Units for quantities of dimension one, or dimensionless quantities

The coherent unit for any quantity of dimension one, also called a dimensionless quantity, is the number one, symbol 1. When the value of such a quantity is expressed, the unit symbol 1 is generally not written out explicitly.

EXAMPLE 1 Refractive index n = 1,53 × 1 = 1,53

Prefixes shall not be used to form multiples or submultiples of this unit. Instead of prefixes, powers of 10 are recommended.

EXAMPLE 2 Reynolds number Re = 1,32 × 10^3

Considering that plane angle is generally expressed as the ratio of two lengths and solid angle as the ratio of two areas, in 1995 the CGPM specified that, in the SI, the radian, symbol rad, and steradian, symbol sr, are dimensionless derived units. This implies that the quantities plane angle and solid angle are considered as derived quantities of dimension one. The units radian and steradian are thus equal to one; they may either be omitted, or they may be used in expressions for derived units to facilitate distinction between quantities of different kind but having the same dimension.

0.4 Numerical statements in this part of ISO/IEC 80000

The sign = is used to denote "is exactly equal to", the sign ≈ is used to denote "is approximately equal to", and the sign := is used to denote "is by definition equal to".

Numerical values of physical quantities that have been experimentally determined always have an associated measurement uncertainty. This uncertainty should always be specified. In this part of ISO/IEC 80000, the magnitude of the uncertainty is represented as in the following example.

EXAMPLE l = 2,347 82(32) m

In this example, $l = a(b)$ m, the numerical value of the uncertainty b indicated in parentheses is assumed to apply to the last (and least significant) digits of the numerical value a of the length l. This notation is used when b represents one standard uncertainty (estimated standard deviation) in the last digits of a. The numerical example given above may be interpreted to mean that the best estimate of the numerical value of the length l when l is expressed in the unit metre is 2,347 82 and that the unknown value of l is believed to lie between (2,347 82 – 0,000 32) m and (2,347 82 + 0,000 32) m with a probability determined by the standard uncertainty 0,000 32 m and the probability distribution of the values of l.

0.5 Remark on logarithmic quantities and their units

The expression for the time dependence of a damped harmonic oscillation can be written either in real notation or as the real part of a complex notation

$$F(t) = A\,\mathrm{e}^{-\delta t} \cos \omega t = \mathrm{Re}\,(A\,\mathrm{e}^{(-\delta + \mathrm{i}\omega)t}), \quad A = F(0)$$

This simple relation involving δ and ω can be obtained only when e (base of natural logarithms) is used as the base of the exponential function. The coherent SI unit for the damping coefficient δ and the angular frequency ω is second to the power minus one, symbol s^{-1}. Using the special names neper, symbol Np, and radian, symbol rad, for the units of δt and ωt, respectively, the units for δ and ω become neper per second, symbol Np/s and radian per second, symbol rad/s, respectively.

Corresponding variation in space is treated in the same manner

$$F(x) = A\mathrm{e}^{-\alpha x}\cos\beta x = \mathrm{Re}(A\mathrm{e}^{-\gamma x}), \quad A = F(0) \qquad \gamma = \alpha + \mathrm{i}\beta$$

where the unit for α is neper per metre, symbol Np/m, and the unit for β is radian per metre, symbol rad/m.

The taking of logarithms of complex quantities is usefully done only with the natural logarithm. In ISO/IEC 80000, the level L_F of a field quantity F is therefore defined by convention as the natural logarithm of a ratio of the field quantity and a reference value F_0, $L_F = \ln(F/F_0)$, in accordance with decisions by CIPM and OIML. Since a field quantity is defined as a quantity the square of which is proportional to power when it acts on a linear system, a factor 1/2 is introduced in the expression of the level of a power quantity, $L_P = (1/2)\ln(P/P_0)$, when defined by convention using the natural logarithm, in order to make the level of the power quantity equal to the level of the corresponding field quantity when the proportionality factors are the same for the considered quantities and the reference quantities, respectively. See IEC 60027-3:2002, subclause 4.2[1].

The neper and the bel, symbol B, are units for such logarithmic quantities. The neper is the coherent unit when the logarithmic quantities are defined by convention using the natural logarithm, 1 Np = 1. The bel is the unit when the numerical value of the logarithmic quantity is expressed in terms of decimal logarithms, 1 B = (1/2) ln 10 Np ≈ 1,151 293. The use of the neper is mostly restricted to theoretical calculations on field quantities, when this unit is most convenient, whereas in other cases, especially for power quantities, the bel, or in practice its submultiple decibel, symbol dB, is widely used. It should be emphasized that the fact that the neper is chosen as the coherent unit does not imply that the use of the bel should be avoided. The bel is accepted by the CIPM and the OIML for use with the SI. This situation is in some respect similar to the fact that the unit degree (…°) is commonly used in practice instead of the coherent SI unit radian (rad) for plane angle.

Generally it is not the logarithmic quantity itself (such as L_F or L_P) that is of interest; it is only the argument of the logarithm that is of interest.

To avoid ambiguities in practical applications of logarithmic quantities the unit should always be written out explicitly after the numerical value, even if the unit is neper, 1 Np = 1. Thus, for power quantities, the level is generally given by $L_P = 10\ \lg(P/P_0)$ dB, and it is the numerical value $10\ \lg(P/P_0)$ and the argument P/P_0 that are of interest. This numerical value is, however, not the same as the quantity L_P, because the unit decibel (or the unit bel) is not equal to one, 1. The corresponding applies to field quantities where the level is generally given by $L_F = 10\ \lg(F/F_0)^2$ dB.

EXAMPLES

The implication of the statement that L_F = 3 dB (= 0,3 B) for the level of a field quantity is to be read as meaning: $\lg(F/F_0)^2 = 0{,}3$, or $(F/F_0)^2 = 10^{0,3}$. It also implies that $L_F \approx 0{,}3 \times 1{,}151\,293 = 0{,}345\,387\,9$ Np, but this is not often used in practice.

Similarly the implication of the statement that L_P = 3 dB (= 0,3 B) for the level of a power quantity is to be read as meaning: $\lg(P/P_0) = 0{,}3$, or $(P/P_0) = 10^{0,3}$. It also implies that $L_P \approx 0{,}3 \times 1{,}151\,293 = 0{,}345\,387\,9$, but this is not often used in practice.

Meaningful measures of power quantities generally require time averaging to form a mean-square value that is proportional to power. Corresponding field quantities may then be obtained as the root-mean-square value. Peak values during specified time intervals are also important. For such applications, the decimal (base 10) logarithm is generally used to form the level of field or power quantities. However, the natural logarithm could also be used for these applications, especially when the quantities are complex.

[1] IEC 60027-3, Letter symbols to be used in electrical technology — Part 3: Logarithmic and related quantities, and their units.

0.6 Introduction specific to 80000-14

0.6.1 The basis for the determination of the quantities and units to be addressed is the taxonomy specified in the Telebiometric Multimodal Model (TMM, see ITU-T Rec. X.1081). In the TMM ten aspects of the interaction between the human body and its environment are recognised (base modalities). These interactions are assumed to occur at various scales of propinquity and at various intensities across the "personal privacy sphere" (see Figure 1 of ITU-T Rec. X.1081).

0.6.2 Using the terminology of the TMM, these interactions (base modalities) are classified as follows (see the definition of terms in clause 3):

- TANGO–IN
- TANGO–OUT
- VIDEO–IN
- VIDEO–OUT
- AUDIO–IN
- AUDIO–OUT
- CHEMO–IN
- CHEMO–OUT
- RADIO–IN
- RADIO–OUT

0.6.3 It is also recognised that the temperature of (parts of) the human body is important both for safe operation of a telebiometric device and for its use in providing telebiometric security. This aspect of the interaction of a human body with its environment uses the base modalities TANGO–IN, TANGO–OUT, VIDEO–IN, and VIDEO–OUT, but is sufficiently important that it is defined in this part of ISO/IEC 80000 as an additional derived modality:

- CALOR–IN describes the absorption of heat by the whole human body mediated by electromagnetic radiation (including infra-red or micro-wave radiation), heat conduction (by direct contact) or heat convection (by a heat transporting liquid or gas).
- CALOR–OUT describes the loss of heat by the whole human body mediated by electromagnetic radiation, heat conduction, heat convection or evaporation.

0.6.4 Clauses 5 to 11 define quantities and units for the in and out aspects of one of the interactions of the human body with a telebiometric device – see [10].

0.6.5 The terminology used in this classification is derived as follows:

- TANGO: from Latin: tangō, -ēre, tetigī, tāctum — Latin, meaning "I touch"

NOTE 1 TANGO–IN has been listed first, because in terms of the development of life, skin sensitivity came first, and other input organs were specialisations of that.

NOTE 2 There are two forms of skin, glabrous and hairy (see Figures 1 and 2). These have different properties for sensitivity (see VIM, 4-12), giving rise to different TANGO–IN units.

- VIDEO: from Latin: videō, -ēre, vīdī, vīsum — Latin, meaning "I see"
- AUDIO: from Latin: audiō, -īre, -īvī (iī), -ītum — Latin, meaning "I hear"
- CHEMO: from Medieval Latin: chemia, from Arabic al-kimia — meaning “chemistry”
- RADIO: from Latin: radiō, -āre, -āvi, ātum — Latin, meaning "I radiate"
  and: Latin: radius, -iī (m) — Latin, meaning "ray, beam"
- CALOR: from Latin: calor, calōris (m) — Latin, meaning "warmth, heat"

0.6.6 In Annex C (normative) a code is specified that can be applied to classify a telebiometric device, and a compact graphical symbol that can be used to represent that code. This is based essentially on whether the device is an actuator or a sensor, and on which modalities it uses.

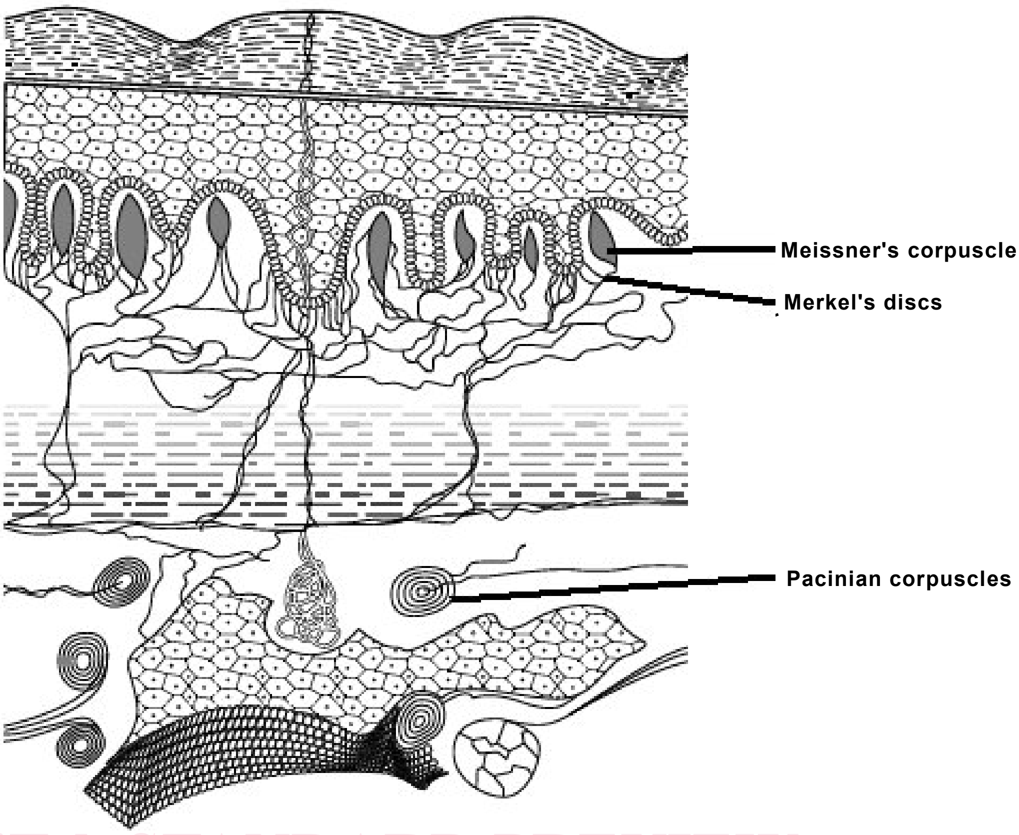

Figure 1 – Schematic drawing of a cross-section of glabrous skin

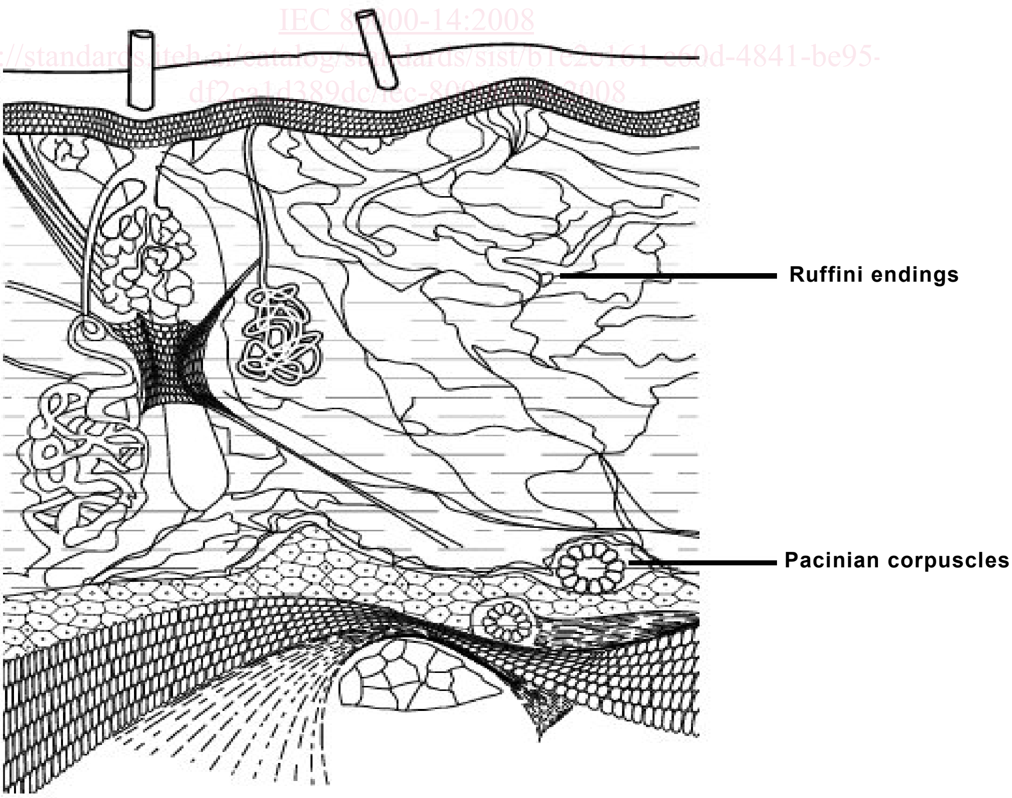

Figure 2 – Schematic drawing of a cross-section of hairy skin

This page is intentionally blank in order to ensure that the tables of Quantities appear on an even numbered page and the tables of units on an odd numbered page.

QUANTITIES AND UNITS –

Part 14: Telebiometrics related to human physiology

1 Scope

In this part of ISO/IEC 80000 names, symbols, and definitions for quantities and units of telebiometrics related to human physiology are given.

This part of ISO/IEC 80000 encompasses quantities and units for physiological, biological or behavioural characteristics that might provide input or output to telebiometric identification or verification systems (recognition systems), including any known detection or safety thresholds.

It also includes quantities and units concerned with effects on a human being caused by the use of a telebiometric device.

NOTE The quantities and units, their names and letter symbols, specified here are those widely used in the disciplines and specialities related to telebiometrics: the telebiometric industry and telebiometry. Telebiometric units are SI units (see ISO 80000-1).

A code and an associated graphical symbol for the identification of the type of a telebiometric device are also specified in this part of ISO/IEC 80000.

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 80000-1, *Quantities and units — Part* 1: *General*[2]

ISO 80000-3:2006, *Quantities and units — Part* 3: *Space and time*

ISO 80000-4:2006, *Quantities and units — Part* 4: *Mechanics*

ISO 80000-5, *Quantities and units — Part* 5: *Thermodynamics*

IEC 80000-6, *Quantities and units — Part* 6: *Electromagnetism*[2]

ISO 80000-7, *Quantities and units — Part* 7: *Light*[2]

ISO 80000-8, *Quantities and units — Part* 8: *Acoustics*

ISO 80000-9, *Quantities and units — Part* 9: *Physical chemistry and molecular physics*[2]

ISO 80000-10, *Quantities and units — Part 10: Atomic and nuclear physics*

ITU-T Rec. X.1081, *The Telebiometric Multimodal Model — A Framework for the Specification of Security and Safety Aspects of Telebiometrics*

VIM (2007), *International Vocabulary of Metrology — Basic and General Concepts and Associated Terms – 3rd edition*

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[2] In preparation.

3 Terms, definitions, abbreviations and symbols

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

3.1 General concepts

3.1.1
base modality
one of the classifications of the interaction of a human body with its environment based on the physical nature of the interaction or on the human sensory system that it affects (see 3.4.1 to 3.4.10)

NOTE If the interaction is from the environment to the human body it is described as an in-modality. If it is from the human body to the environment is described as an out-modality

3.1.2
derived modality
one of the classifications of the interaction of a human body with its environment based on a property of the human body that is determined or changed using one or more of the base modalities (see 3.4.11 to 3.4.12)

NOTE The temperature of the human body or parts of the human body can be detected (CALOR–OUT) by an infrared detector or by conduction to a thermometer and can be changed by convection, conduction, or various forms of radiation (CALOR–IN).

3.1.3
in-modality
modality of interactions from the environment to the human body

3.1.4
out-modality
modality of interactions from the human body to the environment

3.1.5
wetware
that physical aspect of a human being that is affected by or affects telebiometric devices

NOTE This term is not used in the normative text, but it is extensively used in Annex D and the definition is provided here for completeness.

3.1.6
biometrics
automated recognition of individuals based on their behavioural and biological characteristics

NOTE In some other disciplines the meaning of biometrics encompasses counting, measuring and statistical analysis of any kind of data in the biological sciences including the relevant medical sciences.

3.1.7
telebiometrics
application of biometrics to telecommunications and of telecommunications to remote biometric sensing

3.1.8
telebiometric device
sensor or actuator interacting remotely with a human being, using telecommunications

3.1.9
telebiometric multimodal model
model of the interactions of a human being with its environment using modalities based on the human senses.

3.1.10
TMM metric layer
layer in the TMM taxonomy that identifies the SI units used to describe an IN or OUT interaction.

3.1.11
TMM scientific layer
layer in the TMM taxonomy that identifies the scientific discipline that investigates the properties and thresholds of an IN or OUT interaction.