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# JIS Z 8500 : 2002

(JES/JSA)

## Ergonomics—Basic human body measurements for technological design

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## Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Ergonomics Society (JES)/the Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently **JIS Z 8500 : 1994** is replaced with this Standard.

In order to conform to the International Standard, this revision has been prepared based on **ISO 7250 : 1996** *Ergonomics—Basic human body measurements for technological design*.

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# Ergonomics—Basic human body measurements for technological design

**Introduction** This Japanese Industrial Standard has been prepared based on the first edition of **ISO 7250** *Ergonomics—Basic human body measurements for technological design* published in 1996 with modifying some technical contents.

The portions underlined with dots in this Standard are the matters not included in the original International Standard. The list of modified contents is given in the Annex 2 (informative) together with the explanation.

The well-being of people is greatly dependent on their geometrical relationship with various factors such as clothing, places of work, transportation, homes and recreational activities. To ensure harmony between people and their environments, it is necessary to quantify the size and shape of people for optimization of the technological design of the workplace and the home environment.

This Standard may be used in conjunction with national or international regulations or agreements to assure harmony in defining population groups. In its various applications, it is anticipated that the basic list will be supplemented by specific additional measurements.

**1 Scope** This Standard provides a description of anthropometric measurements which can be used as a basis for comparison of population groups.

The basic list specified in this Standard is intended to serve as a guide for ergonomists who are required to define population groups and apply their knowledge to the geometric design of the places where people work and live.

This list is not intended to serve as a guide for how to take anthropometric measurements, but it gives information to the ergonomist and designer on the anatomical and anthropometrical bases and principles of measurement which are applied in the solution of design tasks.

Remarks : The International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO 7250 : 1996 *Ergonomics—Basic human body measurements for technological design* (MOD)

**2 Definitions** For the purposes of this Standard, the following definitions apply:

**2.1 population group** Group of people having some common environment or activity.

**2.2 Anthropometric terms**

- a) **midsagittal plane** Vertical plane dividing the human body into right and left halves.
- b) **sagittal plane** All planes parallel to the midsagittal plane.
- c) **midsagittal line** Line at which the midsagittal plane crosses with the surface of the body.
- d) **frontal plane** Vertical plane perpendicular to the midsagittal plane which divides the body into the front and rear halves.
- e) **distal** Away from the main mass of the body.
- f) **proximal** Part of arms and legs nearest to the torso.
- g) **radial** Side of radius bone in the forearm (thumb side).
- h) **ulnar** Side of ulna bone in the forearm (little finger side).
- i) **tibial** Side of tibial bone in the lower leg (big toe side).
- j) **fibular** Side of fibula bone in the lower leg (little toe side).
- k) **biceps femoris** One of large muscle in the rear side of the thigh.
- l) **deltoid muscle** Large muscle on the lateral border of the upper arm in the shoulder region.
- m) **gluteal fold** Fold of the skin making a boundary between the buttocks and the rear surface of the thigh.
- n) **grip axis** Axis of the fist corresponding with the longitudinal axis of a rod held in the hand.
- o) **lateral** Towards the side of the body.
- p) **medial** Towards the midline of the body.
- q) **Frankfurt plane** Plane determined by three points of right and left tragions and left orbitale.

**3 Measuring points** The points of anthropometric measurement are as given in Table 1 and Figure 1.

Remarks : In order to make the measuring points in the Table 1 correspond to the figure of the human body in the Figure 1, the number of the measuring points is shown in the Figure 1.

**Table 1 Measuring points**

| No. | Measuring point | Definition                                                                                                                                     | Figure to be referred | English equivalent (informative) |
|-----|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------------|
| 1   | TÔTYÔTEN        | The highest point of the head in the midsagittal plane.                                                                                        | Fig. 1 a), b)         | vertex                           |
| 2   | KÔTÔTEN         | The point on the midsagittal line at the most distal position from the glabella.                                                               | Fig. 1 a)             | opistocranion                    |
| 3   | ZISYUTEN        | The point on the root above the tragus (protrusion in front and outside of the ear hole).                                                      | Fig. 1 a)             | tragion                          |
| 4   | SOKUTÔTEN       | The most exterior point on the occiput. The left and right euryons are within the same frontal plane.                                          | Fig. 1 a)             | euryon                           |
| 5   | NUKÂRE          | On the midsagittal line, the lowest touchable point of the occipital bone between the nape muscles.                                            | Fig. 1 a)             | nuchale                          |
| 6   | MIKENTEN        | The most anterior point of the forehead between the brow ridges in the midsagittal line.                                                       | Fig. 1 a)             | glabella                         |
| 7   | BIANTEN         | The cross point of sewn up line between forehead bone and nasal bone, with the midsagittal line.                                               | Fig. 1 a)             | sellion                          |
| 8   | KÔTEN           | The point where the mouth opening (space surrounded by the upper and lower lips) is cut by the midsagittal line.                               | Fig. 1 a)             | stomion                          |
| 9   | OTOGAITEN       | The lowest point of lower edge of the chin on the midsagittal line.                                                                            | Fig. 1 a)             | gnathion                         |
| 10  | GAIGANKAKUTEN   | The point where the upper eyelid joins with the lower eyelid at the corner of the eye.                                                         | Fig. 1 a)             | ectocanthion                     |
| 11  | GANKATEN        | The lowest point of the lower edge of the eye hole (the hole on the head bone where eye ball is kept).                                         | Fig. 1 a)             | orbitale                         |
| 12  | KEITUITEN       | The tip of the spinous process (protuberance projecting from the rear side of each bone of which the spine consists) of 7th cervical vertebra. | Fig. 1 b)             | cervicale                        |

**Table 1** (continued)

| No. | Measuring point     | Definition                                                                                                                                                                                   | Figure to be referred | English equivalent (informative) |
|-----|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------------|
| 13  | KYÔKOTU-TYÛTEN      | The point on the union of the straight line linking the left and right 4th sternebrae (the joint between the sternum and the rib) and the midsagittal line on the front breast surface.      | Fig. 1 b)             | mesosternale                     |
| 14  | KENPÔTEN            | The most exterior point of the outer edge of the hump of the scapula (the large flat and protrusive part of the end of the shelf like protuberance on the back side surface of the scapula). | Fig. 1 b)             | acromion                         |
| 15  | ZEN'EKIKATEN        | The lowest point on the part where the greater pectoral on the front edge of the armpit connects.                                                                                            | Fig. 1 b)             | anterior armpit point            |
| 16  | TYÔKOTU-RYÔTEN      | The most exterior protrusion of the bicristal (height of the bone extending along the upper edge of the pelvis).                                                                             | Fig. 1 b)             | iliocristale                     |
| 17  | TYÔKYOKUTEN         | The point on the lowest edge of the upper and front iliospinale (the protrusion on the front edge of the bicristal).                                                                         | Fig. 1 b)             | iliospinale anterior             |
| 18  | TÔKOTUTEN           | The point on the outside proximal end of the radiale top (the disc-shaped part at the proximal end of the radius).                                                                           | Fig. 1 b)             | radiale                          |
| 19  | TÔKOTU-KEITOTUTEN   | The point on the most distal end of the stylus of the radius (the sharp pointed part of the distal end of the radius).                                                                       | Fig. 1 b), c)         | stylium                          |
| 20  | SYAKKOTU-KEITOTUTEN | The point on the most distal end of the stylus of the ulna (the thin part protruding from the bulge of the ulna).                                                                            | Fig. 1 b), c)         | stylium ulnare                   |
| 21  | TÔSOKU-TYÛSYUTEN    | Of the condyle of the second metacarpus (the bulging part on the distal of the metacarpus), the point protruding most to the radius side.                                                    | Fig. 1 c)             | metacarpale radiale              |
| 22  | SYAKUSOKU-TYÛSYUTEN | Of the condyle of the fifth metacarpus (the bulging part on the distal of the metacarpus), the point protruding most toward the ulna side.                                                   | Fig. 1 c)             | metacarpale ulnare               |

**Table 1** (concluded)

| No. | Measuring point           | Definition                                                                                                                                                                      | Figure to be referred | English equivalent (informative) |
|-----|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------------|
| 23  | <u>SISETUTEN</u>          | The point on the proximal end of the proximal phalanx of finger on the back side of the hand. The phalanges being in every finger are called thumb to little finger phalangion. | Fig. 1 c)             | phalangion                       |
| 24  | <u>SISENTEN</u>           | Of the top of the middle finger, the most distal point.                                                                                                                         | Fig. 1 b), c)         | dactylion                        |
| 25  | <u>TENSITEN</u>           | The point on the highest edge of the great trochanter of the thighbone (the big protrusion on the upper and outer side of the thighbone).                                       | Fig. 1 b)             | trochanterion                    |
| 26  | <u>KEIKOTUTEN</u>         | The highest (proximal) point on the anteromedial margin of the tibia (the bulging part on the upper and inside part of the tibia).                                              | Fig. 1 b)             | tibiale                          |
| 27  | <u>NAIKATEN</u>           | The lowest point of the sphyrion of the tibia (the bulge on the inside of the lowest end of the tibia, namely, the inside ankle).                                               | Fig. 1 b)             | sphyrion                         |
| 28  | <u>GAIKATEN</u>           | The lowest point of the sphyrion fibulare of the fibula (the bulge on the outside of the lowest part of the fibula, namely, the outside ankle).                                 | Fig. 1 b)             | sphyrion fibulare                |
| 29  | <u>SYÔTEN</u>             | The point of the rearmost protrusion of the calcaneus (heel bone).                                                                                                              | Fig. 1 d)             | pternion                         |
| 30  | <u>SOKUSENTEN</u>         | The point of toe end on the position farthest from the heel point.                                                                                                              | Fig. 1 d)             | acropodion                       |
| 31  | <u>KEISOKU-TYÛSOKUTEN</u> | The point protruding most toward the tibia side out of the condyle of the first metatarsale.                                                                                    | Fig. 1 d)             | metatarsale tibiale              |
| 32  | <u>HISOKU-TYÛSOKUTEN</u>  | The point protruding most toward the fibula side out of the condyle of the fifth metatarsale.                                                                                   | Fig. 1 d)             | metatarsale fibulare             |

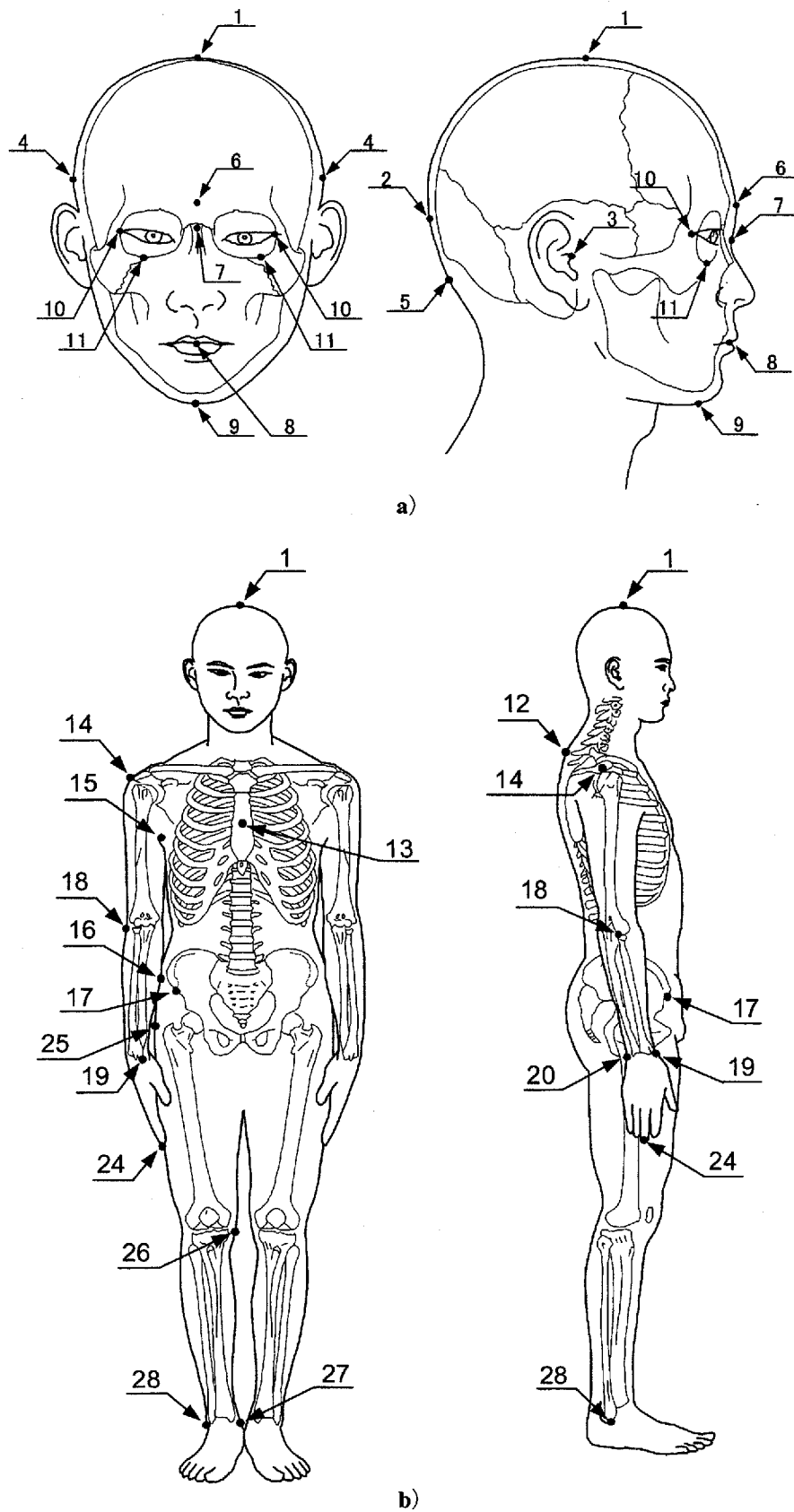


**Figure 1 Measuring points**

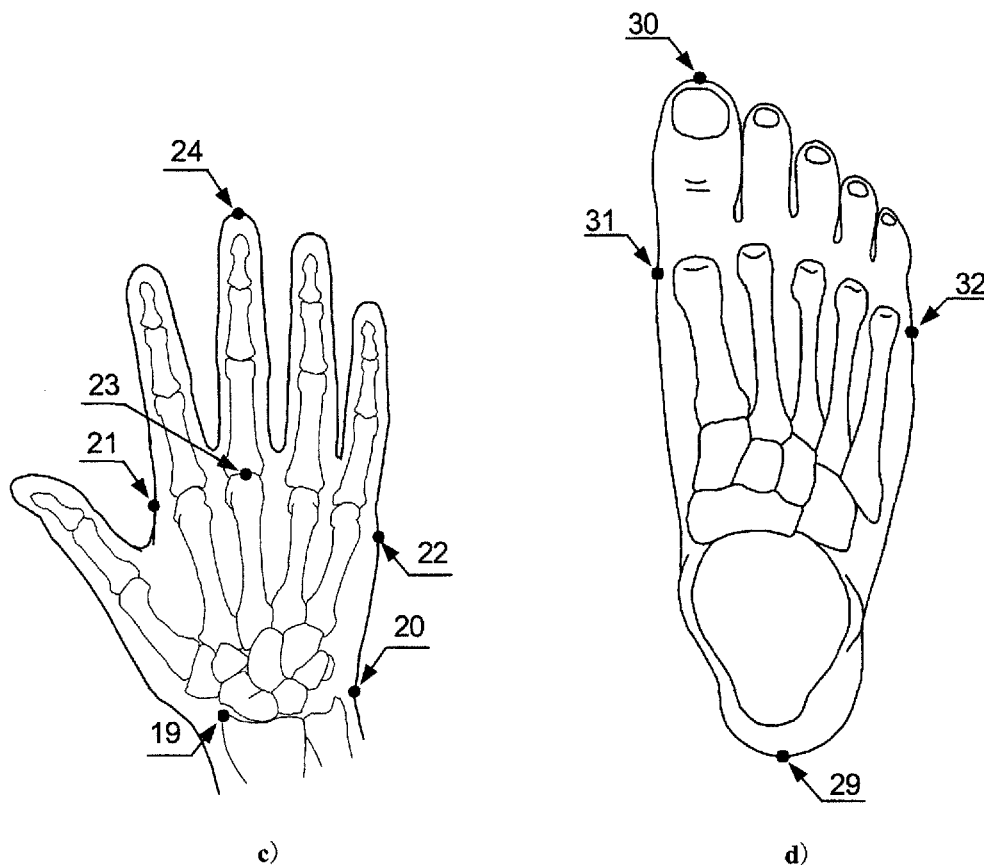


Figure 1 (concluded)

**4 Measuring conditions** It is important that the following conditions are documented together with the numerical results of any survey. Photographs or detailed sketches of measurements and procedures are recommended.

**4.1 Clothing of subject** During measurement, the subject shall be nude or shall wear only minimal clothing and shall be bareheaded and without shoes.

**4.2 Support surfaces** Standing surfaces (floors), platforms or sitting surfaces shall be flat, horizontal and not compressible.

**4.3 Body symmetry** For measurements which may be taken on either side of the body, it is recommended that both sides are measured. If this is not possible, it should be indicated on which side the measurement was taken.

**4.4 Measuring tools** The standard measuring tools which are recommended are the anthropometer, sliding calipers, spreading calipers, weighing scale and tape measure.

**4.4.1 The anthropometer** is a specialized tool for measuring linear distances between points on the body and standard reference surfaces, such as the floor or a seat platform.

**4.4.2 Sliding and spreading calipers** are used for measuring the breadth and depth of body segments, as well as the distances between reference marks.

**4.4.3 A tape measure, measuring cube and rod** are used for measuring body circumferences. To determine the maximal posterior protrusion of a seated person, a measuring cube 200 mm on each side is used. To determine grip measurements, a rod 20 mm in diameter is used.

**4.4.4 Other measuring tools** Section paper is used when measuring linear distances between standard reference surfaces and measuring points unable to be measured by the anthropometer. Height gauge is used when measuring heights from the standard reference surfaces to be measuring points the absolute value of which is small. Measuring cone the diameter of which increases by 5 mm with every 80 mm heights is used for measurements of grip interval diameter. For measuring foot length, a foot length measuring instrument (full wearing type) may be used.

**4.5 Further conditions** For chest and other measurements affected by breathing, it is recommended that they are taken during gentle breathing.

**4.6 Posture in measurement** The basic condition for the posture in the measurements shall be as follows:

- a) **Standing posture** The subject stands erect extending the backbone line without strain, making shoulder feel easy, hanging free the upper limbs down and hold the both heels together.
- b) **Sitting posture** The subject sits extending the backbone line without strain, making shoulder feel easy, hanging free the upper limbs down and crooking both elbows at approximately right angle. As for the lower limbs, the left and right thighs are kept approximately parallel to each other, the both knees are put at approximately right angle and the soles are attached to the floor.
- c) **Frankfurt plane** The Frankfurt plane is kept approximately horizontal.

**5 Measuring items** The basic measuring items of anthropometric measurements shall be as given below. The measuring items and the posture in measurements are shown in the Attached Figure 1 as a whole.

Thigh length and lower leg length are shown in the Annex 1.

Remarks 1 If the same items are in **ISO 7250 : 1996**, the item numbers of **ISO 7250 : 1996** are given in parentheses.

2 In order to make the measuring items given in the following correspond to the general view in the Attached Figure 1, the ideographs of measuring items are given in the Attached Figure 1 except the body weight.

## 5.1 Items on the head

### 5.1.1 Total head height

Description: Vertical distance from vertex to the gnathion.

Method: Subject keeps the head to be orientated in the Frankfurt plane.

Instrument: Large sliding caliper

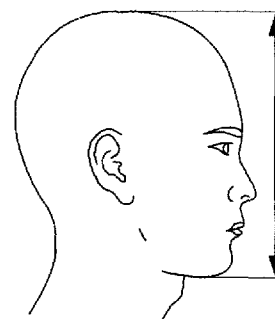


Figure 5.1.1

### 5.1.2 Tragion to vertex height

Description: Vertical distance from the vertex to the tragion.

Method: Subject keeps the head to be orientated in the Frankfurt plane.

Instrument: Large sliding caliper

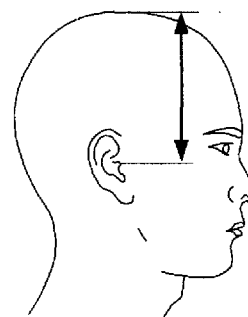


Figure 5.1.2

### 5.1.3 Ectocanthion to vertex height

Description: Vertical distance from the vertex to the ectocanthion.

Method: Subject keeps the head to be orientated in the Frankfurt plane.

Instrument: Large sliding caliper

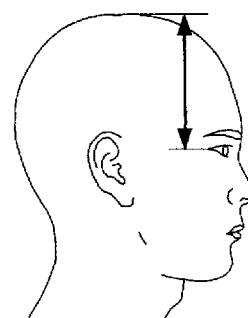


Figure 5.1.3

#### 5.1.4 Stomion to vertex height

Description: Vertical distance from the vertex to the stomion.

Method: Subject keeps the head to be orientated in the Frankfurt plane.

Instrument: Large sliding caliper

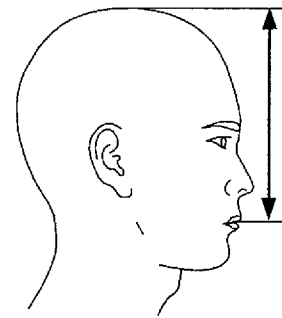


Figure 5.1.4

#### 5.1.5 Face length (ISO 7250 : 4.3.11)

Description: Distance along a straight line between the sellion to the gnathion.

Method: Subject keeps the month closed.

Instrument: Spreading caliper

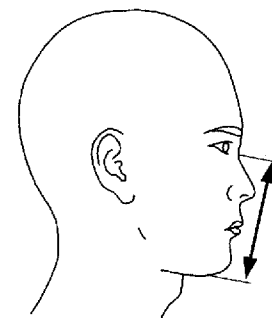


Figure 5.1.5

#### 5.1.6 Head length (ISO 7250 : 4.3.9)

Description: Distance along a straight line between the glabella and the opistocranion.

Method: Position of head has no influence on the measurement.

Instrument: Spreading caliper

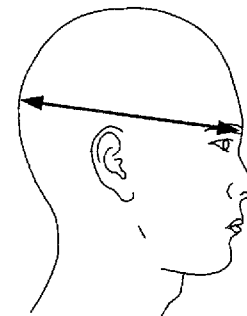


Figure 5.1.6

#### 5.1.7 Occiput to ectocanthion distance

Description: Distance along a horizontal straight line between the vertical wall surface the rearmost point of the skull touches and the ectocanthion.

Method: Subject makes the rearhead touch close vertical wall surface and keeps the head to be orientated in the Frankfurt plane.

Instrument: Anthropometer

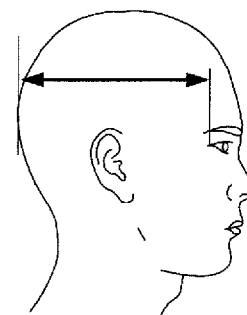


Figure 5.1.7

#### **5.1.8 Occiput to stomion distance**

Description: Distance along a horizontal straight line between the vertical wall surface the rearmost point of the skull touches and the stomion.

Method: Subject makes the rearhead touch close vertical wall surface and keeps the head to be orientated in the Frankfurt plane.

Instrument: Anthropometer

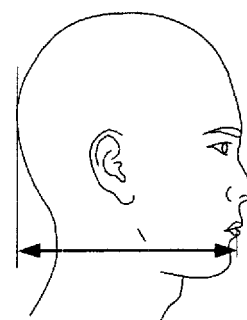


**Figure 5.1.8**

#### **5.1.9 Occiput to tragon distance**

Description: Distance along a horizontal straight line between the vertical wall surface the rearmost point of the skull touches and the tragon.

Method: Subject makes the rearhead touch the vertical wall surface and keeps the head to be orientated in the Frankfurt plane.

Instrument: Anthropometer

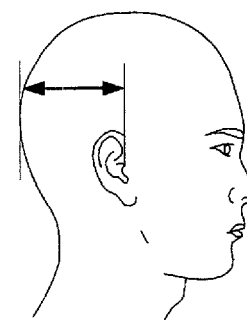


**Figure 5.1.9**

#### **5.1.10 Head breadth (ISO 7250 : 4.3.10)**

Description: Maximum breadth of head above the ears, measured perpendicular to the midsagittal plane.

Method: Position of head has no influence on the measurement.

Instrument: Spreading caliper

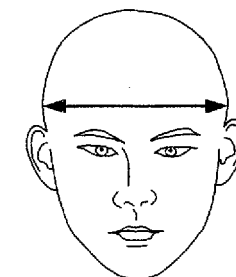


**Figure 5.1.10**

#### **5.1.11 Bitragon breadth**

Description: Distance along a straight line between the right and left bitragions.

Method: Position of head has no influence on the measurement.

Instrument: Spreading caliper

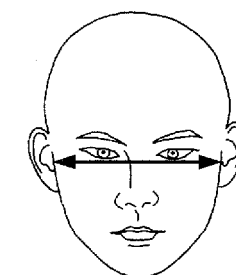


**Figure 5.1.11**

#### 5.1.12 Interpupillary breadth

Description: Distance along a straight line between the pupil centres when seeing forward horizontally.

Method: Subject sees forward horizontally.

Instrument: Sliding caliper

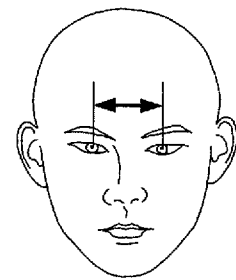


Figure 5.1.12

#### 5.1.13 Head circumference (ISO 7250 : 4.3.12)

Description: Circumference of head measured along line starting from and coming to the glabella passing through the opistocranium.

Method: Tape measure is held on the glabella and led around the head so as to pass over the rearmost point of the skull. Hair shall be included in the measurement.

Instrument: Tape measure

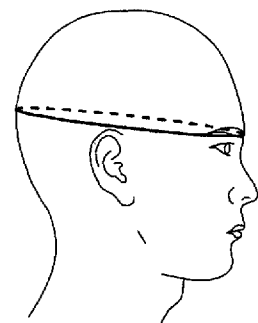


Figure 5.1.13

#### 5.1.14 Sagittal arc (ISO 7250 : 4.3.13)

Description: Length of arc from the glabella to the nuchale passing through the vertex along the head surface.

Method: Tape measure is held on the glabella and led over the head so as to pass over the vertex and the rearmost point of the skull for measuring the distance to the nuchale.

Instrument: Tape measure

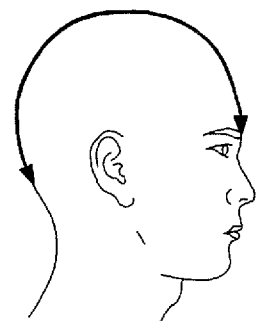


Figure 5.1.14

#### 5.1.15 Bitrignon arc (ISO 7250 : 4.3.14)

Description: Length of arc from one trignon over the crown of the head to other trignon passing over the vertex.

Method: Tape measure is hold on the trignon of one side of the head and led over the crown to the trignon on the other side. Hair shall be included in the measurement.

Instrument: Tape measure

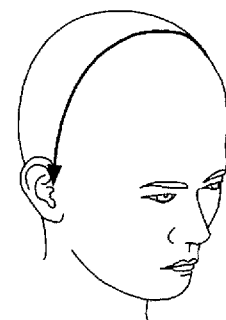


Figure 5.1.15

## 5.2 Measurements taken while subject stands

### 5.2.1 Body mass (weight) (ISO 7250 : 4.1.1)

Description: Total mass (weight) of the body.

Method: Subject stands on a weighing scale.

Instrument: Weighing scale

### 5.2.2 Stature (body height) (ISO 7250 : 4.1.2)

Description: Vertical distance from the floor to the vertex.

Method: Subject takes standing posture and keeps the head to be orientated in the Frankfurt plane.

Instrument: Anthropometer

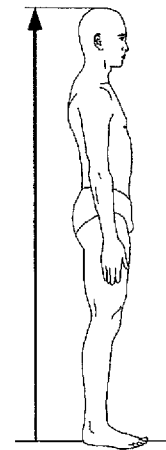


Figure 5.2.2

### 5.2.3 Eye height (ISO 7250 : 4.1.3)

Description: Vertical distance from the floor to the ectocanthion.

Method: Subject takes standing posture and keeps the head to be orientated in the Frankfurt plane.

Instrument: Anthropometer

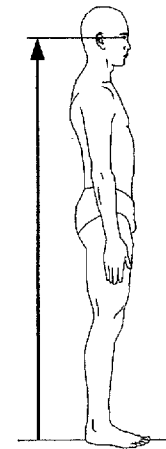


Figure 5.2.3

### 5.2.4 Cervicale height

Description: Vertical distance from the floor to the cervicale.

Method: Subject takes standing posture and keeps the head to be orientated in the Frankfurt plane.

Instrument: Anthropometer

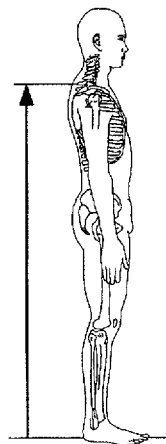


Figure 5.2.4

#### **5.2.5 Shoulder height (ISO 7250 : 4.1.4)**

Description: Vertical distance from the floor to the acromion.

Method: Subject takes standing posture.

Instrument: Anthropometer

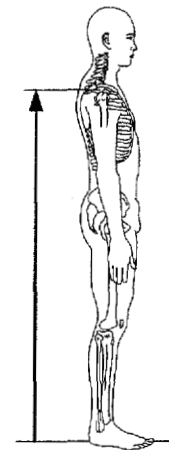


**Figure 5.2.5**

#### **5.2.6 Anterior axillary height**

Description: Vertical distance from the floor to the anterior arm-pit point.

Method: Subject takes standing posture.

Instrument: Anthropometer

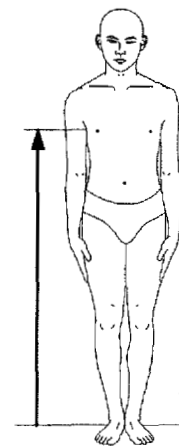


**Figure 5.2.6**

#### **5.2.7 Radiale height**

Description: Vertical distance from the floor to the radiale.

Method: Subject takes standing posture.

Instrument: Anthropometer

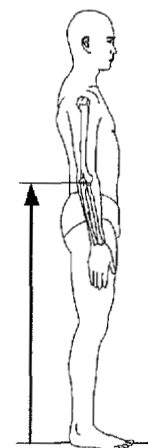


**Figure 5.2.7**

### 5.2.8 Radiale stylium height

Description: Vertical distance from the floor to the stylium.

Method: Subject takes standing posture.

Instrument: Anthropometer

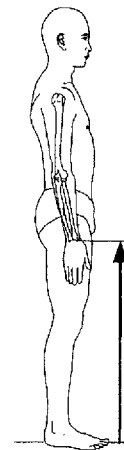


Figure 5.2.8

### 5.2.9 Dactylion height

Description: Vertical distance from the floor to the dactylion.

Method: Subject takes standing posture. The fingers are extended.

Instrument: Anthropometer

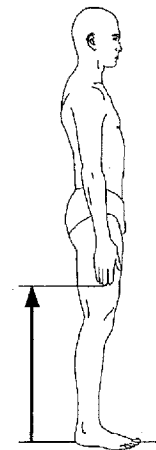


Figure 5.2.9

### 5.2.10 Elbow height (ISO 7250 : 4.1.5)

Description: Vertical distance from the floor to the lowest bony point of the bent elbow.

Method: Subject takes standing posture. Upper arm hangs freely downwards, elbow is flexed at right angle, palm is faced inward and forearm is extended forward.

Instrument: Anthropometer

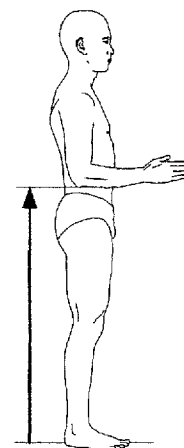


Figure 5.2.10

#### 5.2.11 Fist (grip axis) height (ISO 7250 : 4.4.4)

Description: Vertical distance from the floor to the grip axis of the fist.

Method: Subject takes standing posture. Hand holds the measuring rod in the sagittal plane with grip axis horizontal.

Instrument: Anthropometer, 20 mm diameter rod

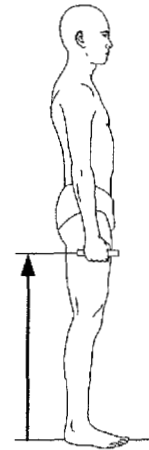


Figure 5.2.11

#### 5.2.12 Dactylian height, over head

Description: Vertical distance from the floor to the dactylian when the arms are extended upward.

Method: Subject takes standing posture, with the arms raised.

Instrument: Section paper.

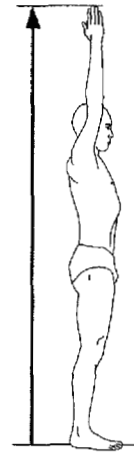


Figure 5.2.12

#### 5.2.13 Iliac spine height, standing (ISO 7250 : 4.1.6)

Description: Vertical distance from the floor to the anterosuperior iliac spine (the most downward-directed point of the iliac crest).

Method: Subject takes standing posture.

Instrument: Anthropometer

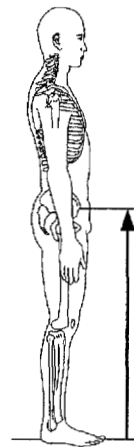


Figure 5.2.13