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भारतीय मानक मसौदा
मशीनरी की सुरक्षा के लिए एर्गोनोमिक डिज़ाइन
भाग 3 एंथ्रोपोमेट्रिक डेटा
(IS 15836 का दूसरा पुनरीक्षण)

Draft Indian Standard
Ergonomic Design for the Safety of Machinery
Part 3 Anthropometric Data
(*Second Revision of IS 15836*)

ICS 13.110; 13.180

Ergonomics Sectional Committee, PGD 15

Last Date for receiving comments: **09 July 2024**

FOREWORD

(Formal clauses of the foreword shall be added later on.)

This standard specifies current requirements for human body measurements (anthropometric data) that are required by Parts 1 and 2 of this standard for the calculation of access-opening dimensions as applied to machinery. This standard was previously an identical adoption of ISO 15534-3 : 2000 'Ergonomic design for the safety of machinery – Part 3 : Anthropometric data' in which anthropometric data from European surveys were available. In this revision, the anthropometric data of the Indian population have also been included.

The anthropometric data originate from static measurements of persons wearing minimum clothing and do not take into account body movements, other clothing, equipment, machinery operating conditions or environmental conditions.

Most of these data are based on information from anthropometric surveys of Indian agricultural workers for farm equipment design carried out during the period 2003-2007 in different regions of the country. A total of 12 525 participants (8 025 male and 4 500 female) from different regions all over India (from 12 states of Union of India, namely Arunachal Pradesh, Gujarat, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Orissa, Punjab, Tamil Nadu, Uttar

Pradesh and West Bengal) were surveyed. Some of the data are from other sources as mentioned in the bibliography (Annex A).

Measurements are given, as required by Parts 1 and 2 of this standard for the 5th, 95th and 99th percentile of the relevant population group within India. This standard shows how to combine the anthropometric data with suitable allowances to take these factors into account.

This standard has been published in three parts. Other parts in this series are:

Part 1 Principles for determining the dimensions required for openings for whole-body access into machinery

Part 2 Principles for determining the dimensions required for access openings

Draft Indian Standard
Ergonomic Design for the Safety of Machinery
Part 3 Anthropometric Data
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1 SCOPE

This standard specifies current requirements for human body measurements (anthropometric data), that are required by IS 15836 (Part 1) and (Part 2) for the calculation of access-opening dimensions as applied to machinery.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

| <i>IS No.</i> | <i>Title</i> |
|-----------------------------|--|
| IS 15836 (Part 1) : 2008 | Ergonomic design for the safety of machinery : Part 1 principles for determining the dimensions required for openings for whole-body access into machinery |
| IS 15836 (Part 2) : 2008 | Ergonomic design for the safety of machinery : Part 2 principles for determining the dimensions required for access openings. |
| IS 13214 (Part 1) : 2020 | Basic human body measurements for technological design : Part 1 body measurement definitions and landmarks |

3 GENERAL REQUIREMENTS

Anthropometric measurements form the basis upon which minimum dimensions of access openings can be calculated. Where machinery requires access openings, the provisions of IS 15836 (Part 1) (for whole body access) and IS 15836 (Part 2) (for access of parts of the body) shall be complied with.

Table 1 gives the human body measurements necessary to calculate the size of access openings taking account of the known range of body sizes of Indian population. The symbols used in Tables 1 and 2 are common to IS 15836 (Part 1) and IS 15836 (Part 2). Appropriate values from Table 1 shall be substituted in the formulae in 4 of IS 15836 (Part 1) and 4 of IS 15836 (Part 2) in order to calculate the dimensions of particular access openings.

4 ANTHROPOMETRIC DATA

4.1 Human Body Measurements (Anthropometric Data from Indian Surveys)

4.1.1 Each of the anthropometric values given in Table 1 can be established according to one of the following two methods:

- a) For national surveys with pooled female and male populations, the corresponding value of the 5th, 95th and 99th percentile is used.
- b) For national surveys with separate female and male percentiles, the mean of the female and male value of the 5th percentile (value of the 95th and 99th percentile respectively) is calculated (Although this is not strictly accurate statistically, it is a good practical approximation). For the value of the 5th percentile, the lower of these calculated values is chosen, and for the values of the 95th and 99th percentiles, the highest value is chosen.

4.1.2 The anthropometric values given in Table 1 are based on the currently available data from Indian surveys. The data estimate the values of the 5th, 95th and 99th percentiles for pooled female and male populations (unless otherwise stated).

Table 1 Anthropometric Data from Indian Surveys
(Clause 4.1)

| Sl No. (1) | Symbol (2) | Explanation (3) | Value <i>mm</i> (4) |
|---------------|---------------|---|------------------------|
| i) | h_1 | Stature (body height) P95 | 1730 |
| ii) | h_1 | Stature (body height) P99 | 1790 |
| iii) | h_8 | Ankle height P95 | 95 |
| iv) | a_1 | Elbow-to-elbow breadth P95 | 450 |
| v) | a_1 | Elbow-to-elbow breadth P99 | 485 |
| vi) | a_3 | Hand breadth with thumb P95 | 108 |
| vii) | a_4 | Hand breadth at metacarpals P95 | 89 |
| viii) | a_5 | Index finger breadth, proximal P95 | 22 |
| ix) | a_6 | Foot breadth P95 | 108 |
| x) | b_1 | Body depth , standing P95 | 283 |
| xi) | b_2 | Grip reach; forward reach P5 | 600 |
| xii) | b_2 | Grip reach; forward reach P95 | 804 |
| xiii) | b_2 | Grip reach; forward reach P99 | 860 |
| xiv) | b_3 | Hand depth at palm P95 | 40 |
| xv) | b_4 | Hand depth at thumb P95 | 50 |
| xvi) | c_1 | Buttock-knee length (thigh length) P95 | 588 |
| xvii) | c_1 | Buttock -knee length (thigh length) P99 | 620 |
| xviii) | c_2 | Foot length P5 | 210 |
| xix) | c_2 | Foot length P95 | 265 |
| xx) | c_2 | Foot length P99 | 277 |
| xxi) | c_3 | Head length from tip of nose P95 | 225 |
| xxii) | d_1 | Upper-arm diameter P95 | 117 |
| xxiii) | d_2 | Lower-arm diameter P95 | 84 |
| xxiv) | d_3 | Fist diameter P95 | 94 |
| xxv) | t_1 | Operating-arm length P5 | 496 |
| xxvi) | t_2 | Forearm reach P5 | 232 |
| xxvii) | t_3 | Arm reach to the side P5 | 648 |
| xxviii) | t_4 | Hand length P5 | 155 |
| xxix) | t_5 | Hand length to thumb P5 | 88 |
| xxx) | t_6 | Index finger length P5 | 60 |

4.2 Descriptions of Human Body Measurements

The descriptions of the human body measurements presented in IS 15836 (Part 1) and IS 15836 (Part 2) are taken from IS 13214 (Part 1). Other human body measurements are produced by the addition or subtraction of two measurements taken from IS 13214 (Part 1) or from other sources listed in the bibliography. The specific measurements and descriptions are given in Table 2.

Table 2 Symbols of Human Body Measurements
(Clause 4.2)

| Sl No. | Symbol | Explanation | Definition source IS 13214 (Part 1) or other as stated |
|--------|--------|---|---|
| (1) | (2) | (3) | (4) |
| i) | h_1 | Stature (body height) | 6.1.2 |
| ii) | h_8 | Ankle height | See medial malleolus height |
| iii) | a_1 | Elbow-to-elbow breadth | 6.2.9 |
| iv) | a_3 | Hand breadth with thumb | Hand breadth across thumb |
| v) | a_4 | Hand breadth at metacarpals | 6.3.3 |
| vi) | a_5 | Index finger breadth, Proximal | 6.3.5 |
| vii) | a_6 | Foot breadth | 6.3.8 |
| viii) | b_1 | Body depth. standing | 6.1.10 |
| ix) | b_2 | Grip reach; forward reach | 6.4.2 |
| x) | b_3 | Hand depth at palm | Hand thickness at metacarpal-III |
| xi) | b_4 | Hand depth at thumb | Hand depth at thumb base |
| xii) | c_1 | Buttock knee length (thigh length) | 6.4.8 |
| xiii) | c_2 | Foot length | 6.3.7 |
| xiv) | c_3 | Head length from tip of nose: head length + fixed value 30 mm | 6.3.9 |
| xv) | d_1 | Upper-arm diameter | Calculated from auxiliary arm circumference |
| xvi) | d_2 | Lower arm diameter | Calculated from relaxed forearm circumference |
| xvii) | d_3 | Fist diameter | Calculated from fist circumference |
| xviii) | t_1 | Operating arm length | Shoulder grip length – Wall to acromion distance |
| xix) | t_2 | Forearm reach | Elbow grip length – (Forearm hand length – coronoid fossa length) |
| xx) | t_3 | Arm reach to the side | Arm reach from wall – wall to acromion distance |
| xxi) | t_4 | Hand length | 6.3.1 |
| xxii) | t_5 | Hand length to thumb | Value taken from ISO 15534-3 |
| xxii) | t_6 | Index-finger length | Length of index finger |

Annex A
(Foreword)
BIBLIOGRAPHY

- i) ISO 15534-3: 2000 Ergonomic design for the safety of machinery – Part 3: Anthropometric data. International Organisation of Standardisation
- ii) Chakrabarti, (D) – Indian Anthropometric Dimensions for Ergonomic Design Practice. National Institute of Design, ISBN 81-86199-15-0, 1997
- iii) Gite (L P), Majumder (J), Mehta (C R), and Khadatkar (A). Anthropometric and Strength Data of Indian Agricultural Workers for Farm Equipment Design 2009 Book No.: CIAE/2009/4. Central Institute of Agricultural Engineering. Bhopal, India. ISBN: 978-81-909305-0-5.
- iv) Maitra (A), Maitra (C), Jha (D K), and Biswas (Rakesh). Finger Length Ratio (2D:4D) In Central India and an Attempt to Verify Fraternal Birth Order Effect: A population based cross-sectional study. J Clin Diagn Res. 2016 Dec; 10(12): CC09–CC12