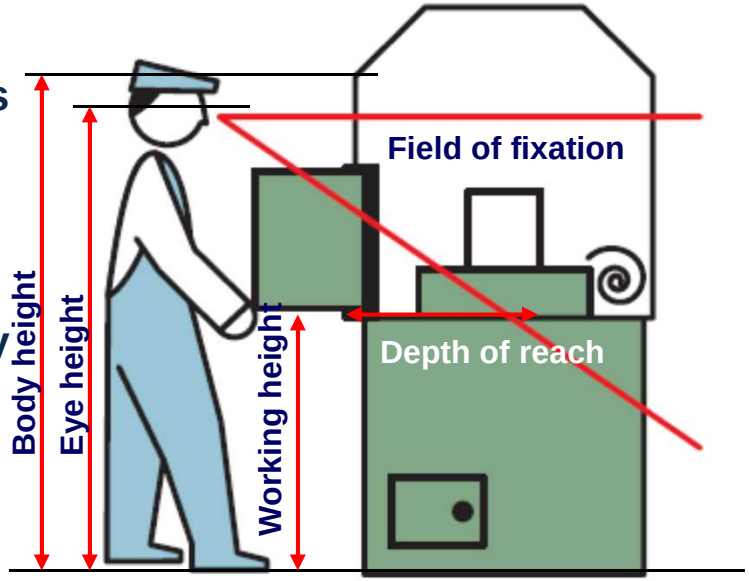
Distribution and differentiation of body dimensions, and sources of data for body dimensions

Overview

Body height classes and body dimensions

Factors influencing the variance in body dimensions

Operator population



Ergonomic requirement characteristics for the user-oriented dimensional design of products and workplaces

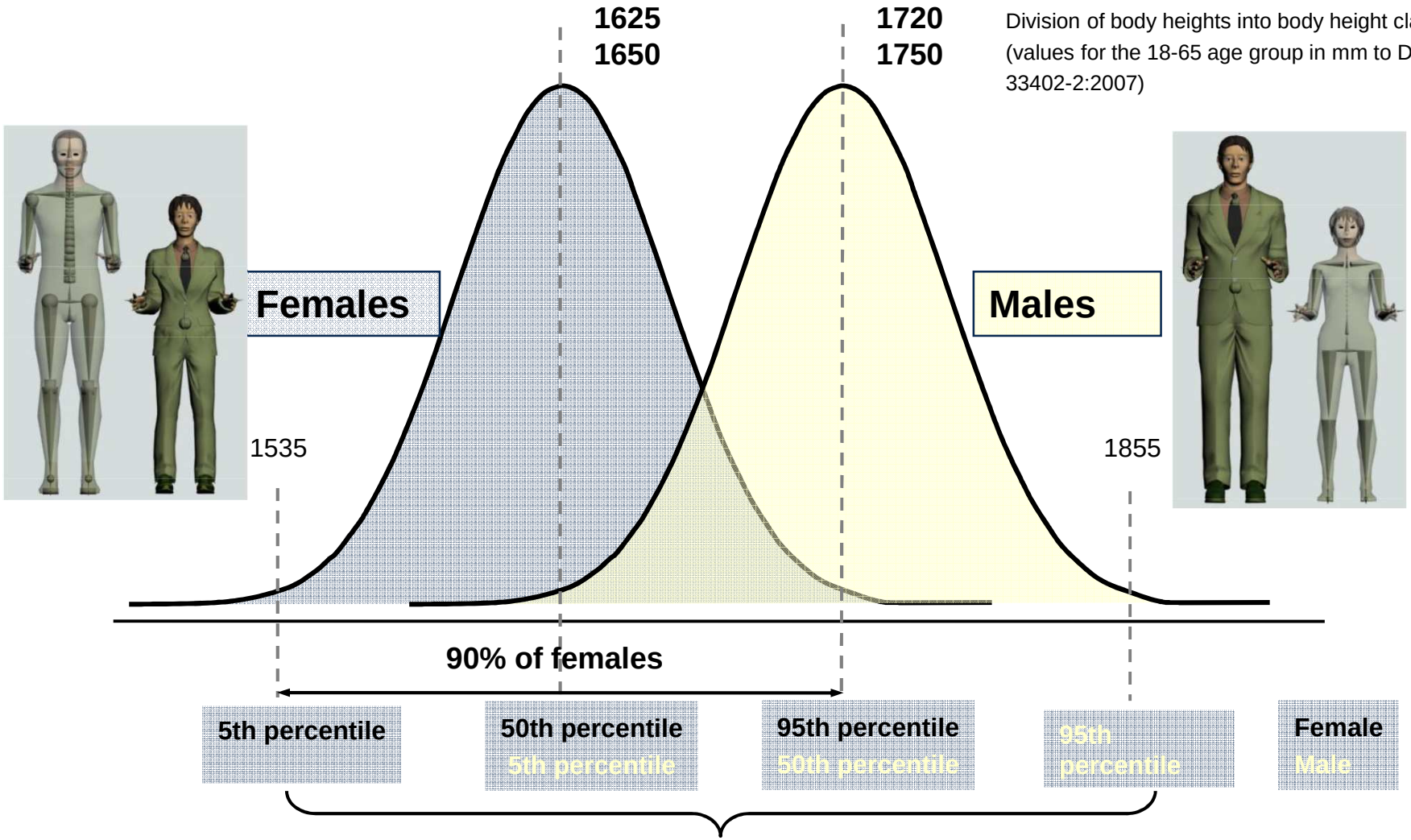
Geometric design of products with consideration for the widest anthropometric variance within the operator population

Sources of data for body dimensions and normative references

Requirement categories of the user-oriented dimensional design of products and workplaces:

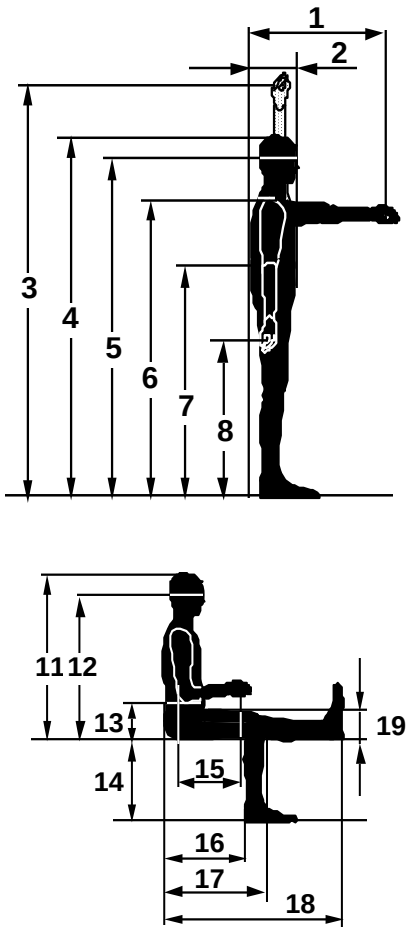
- Safety (observance of safety distances)
- Reachability, functional reliability (e.g. in relation to the actuation of manual controls)
- Adequate freedom of movement (accessibility for parts of the body, space envelopes, active areas)
- Physiologically favourable postures (adaptation to changing loads)
- Reliable, low-fatiguing handling of objects
- Optimization of the visual geometry (visual dimensions, angles of view, fields of view)

Body height classes



Body dimensions to DIN 33 402-2:2007 – excerpt

Nach DIN 33402-2: 2005-12		Perzentile					
(unbekleidete Personen, 18 –65 Jahre)		männlich			weiblich		
	Abmessungen (in cm)	**5.**	**50.**	**95.**	**5.**	**50.**	**95.**
1	Reichweite nach vorn	68,5	74,0	81,5	62,5	69,0	75,0
2	Körpertiefe	26,0	28,5	38,0	24,5	29,0	34,5
3	Reichweite nach oben (beidarmig)	197,5	207,5	220,5	184,0	194,5	202,5
4	Körperhöhe	165,0	175,0	185,5	153,5	162,5	172,0
5	Augenhöhe	153,0	163,0	173,5	143,5	151,5	160,5
6	Schulterhöhe	134,5	145,0	155,0	126,0	134,5	142,5
7	Ellbogenhöhe über der Standfläche	102,5	110,0	117,5	96,0	102,0	108,0
8	Höhe der Hand über der Standfläche	73,0	76,5	82,5	67,0	71,5	76,0
11	Körpersitzhöhe (Stammlänge)	85,5	91,0	96,5	81,0	86,0	91,0
12	Augenhöhe im Sitzen	74,0	79,5	85,5	70,5	75,5	80,5
13	Ellbogenhöhe über der Sitzfläche	21,0	24,0	28,5	18,5	23,0	27,5
14	Länge d. Untersch. m. Fuß	41,0	45,0	49,0	37,5	41,5	45,0
15	Ellbogen-Griffachsen-Abstand	32,5	35,0	39,0	29,5	31,5	35,0
16	Sitztiefe	45,0	49,5	54,0	43,5	48,5	53,0
17	Gesäß-Knie-Länge	56,5	61,0	65,5	54,5	59,0	64,0
18	Gesäß-Bein-Länge	96,5	104,5	114,0	92,5	99,0	105,5
19	Oberschenkelhöhe	13,0	15,0	18,0	12,5	14,5	17,5

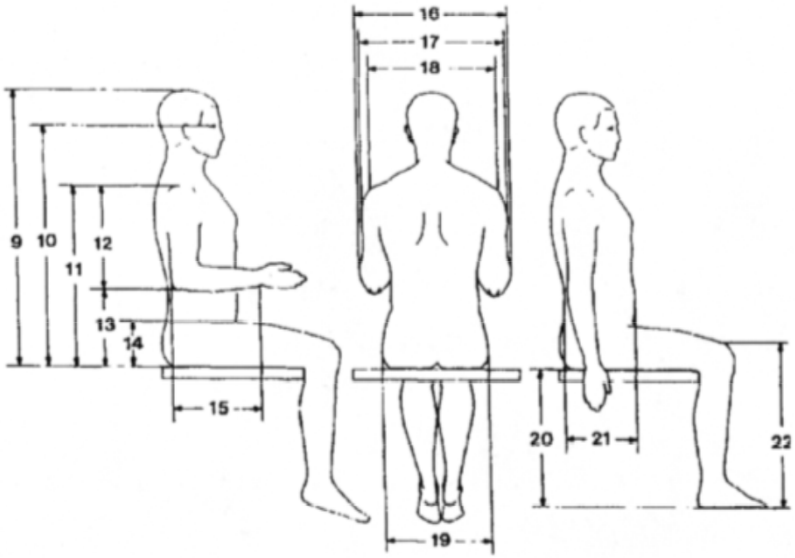


Sources of data for body dimensions and normative references

Values for body dimensions according to "Arbeitswissenschaftliche Erkenntnisse Nr. 108"

Maß-Nr. (lt. Abb.)	Beschreibung des Maßes	Perzentile		
		5	50	95
9	Sitzhöhe (Körpersitzhöhe, Stammlänge)	790	905	985
10	Augenhöhe	680	790	860
11	Schulterhöhe	510	623	695
12	Schulter-Ellenbogen-Länge	288	346	410
13	Ellenbogenhöhe	190	243	280
14	Oberschenkelhöhe	112	146	170
15	Ellenbogen-Handgelenk-Länge	240	279	318
16	Breite über den Ellenbogen	390	478	540
17	Schulterbreite (bideltoid)	395	474	485
18	Schulterbreite (biacromial)	320	380	425
19	Hüftbreite	333	368	440
20	Länge des Unterschenkels mit Fuß	380	444	495
21	Bauchtiefe	195	237	350
22	Kniehöhe	460	530	602

"European human being"



Based upon: Arbeitswissenschaftliche Erkenntnisse Nr. 108, Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, Dortmund 1998

Factors influencing the body dimensions

Sex

e.g. body height

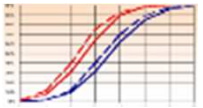
Male ⇔ female approx. 13 cm

Age

e.g. body height (50th percentile)
Age 20-24 ⇔ 60-64
1765 mm ⇔ 1685 mm
Approx. 8 cm

Secular acceleration

e.g. body height



***Former* increase per decade: approx. 1 cm**

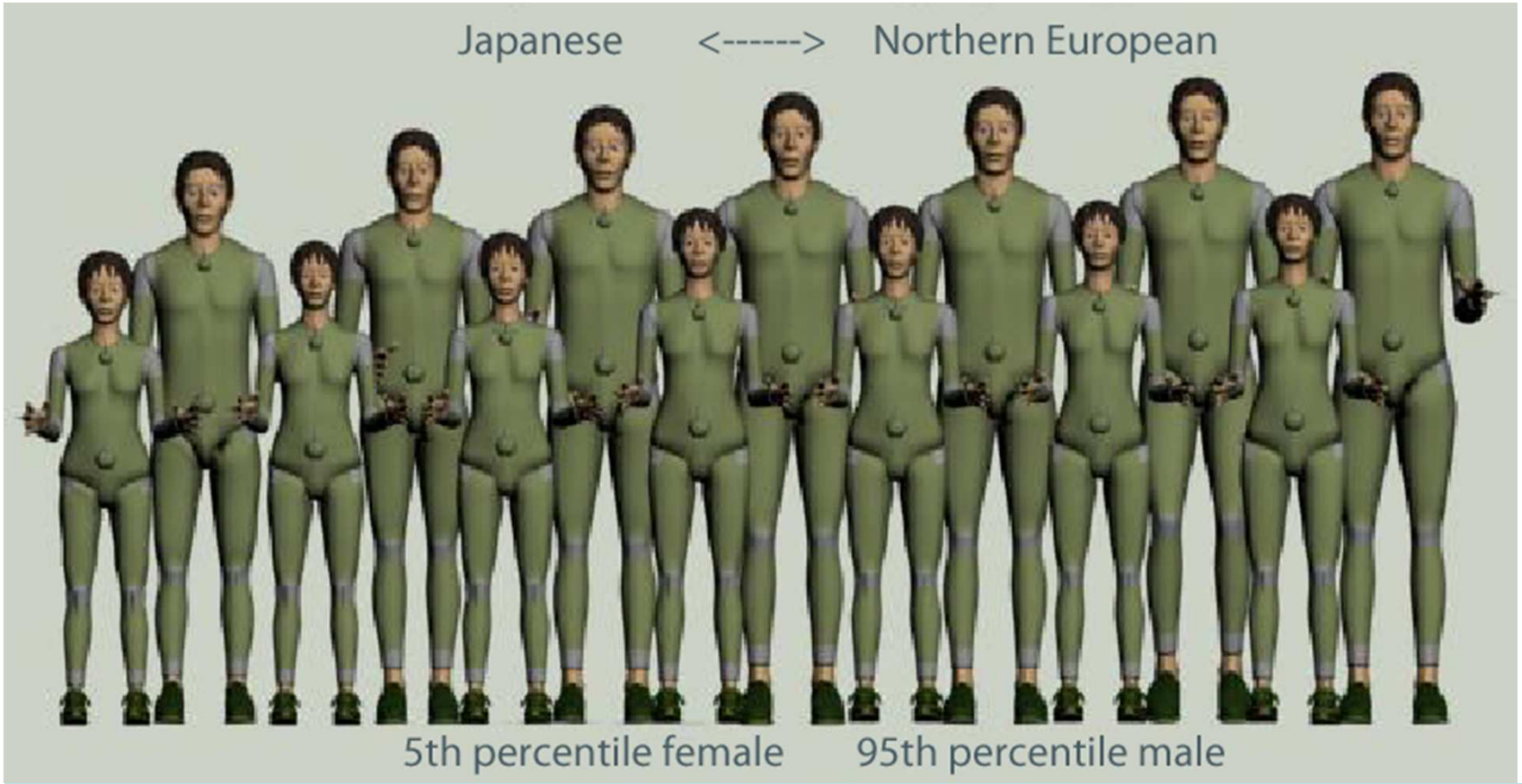
Ethnic differences

e.g. body height

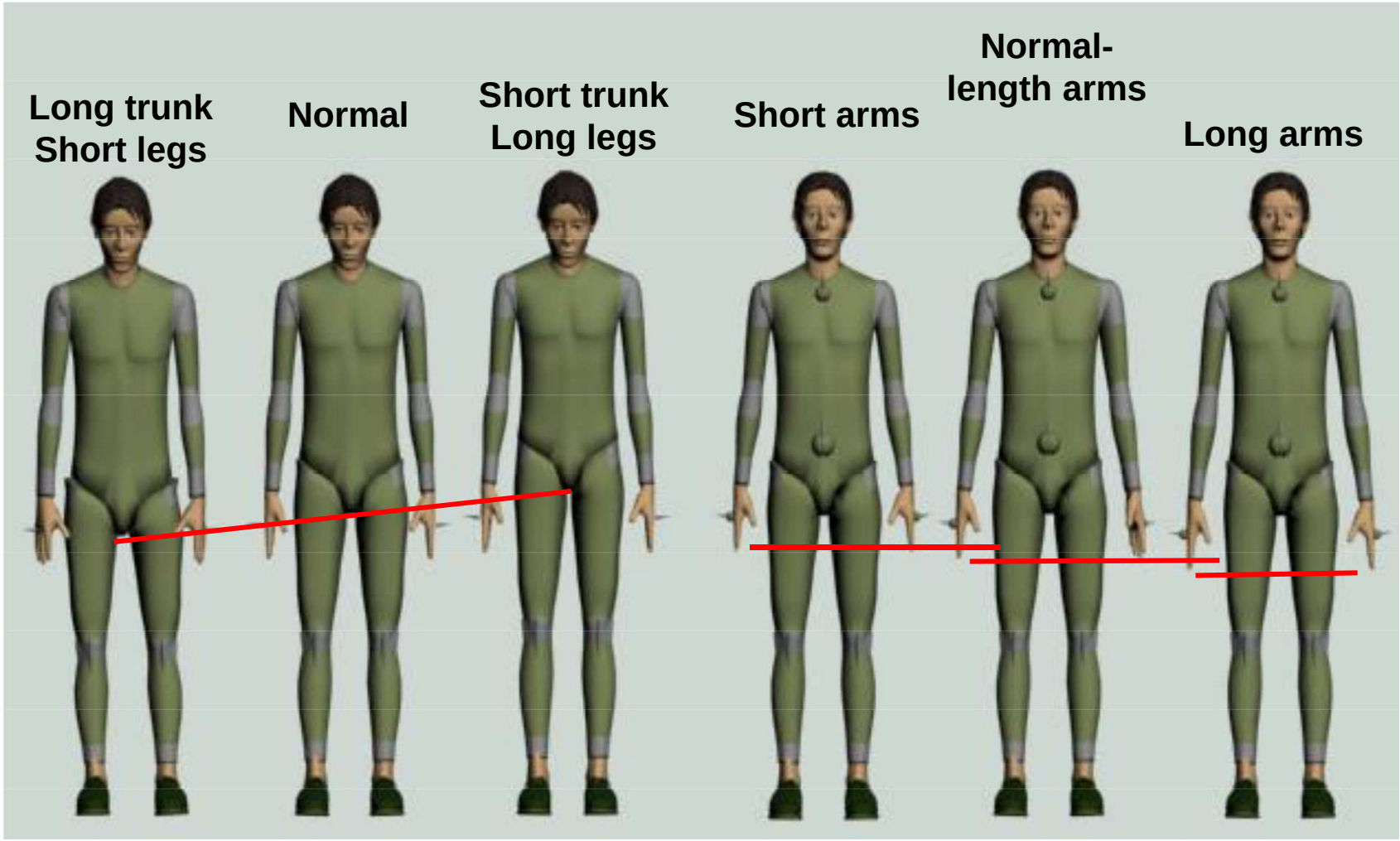
Northern Europeans > Southern Europeans approx. 8 cm

Differences in proportions

International body dimensions – ethnic differences



Trunk/leg length; arm length

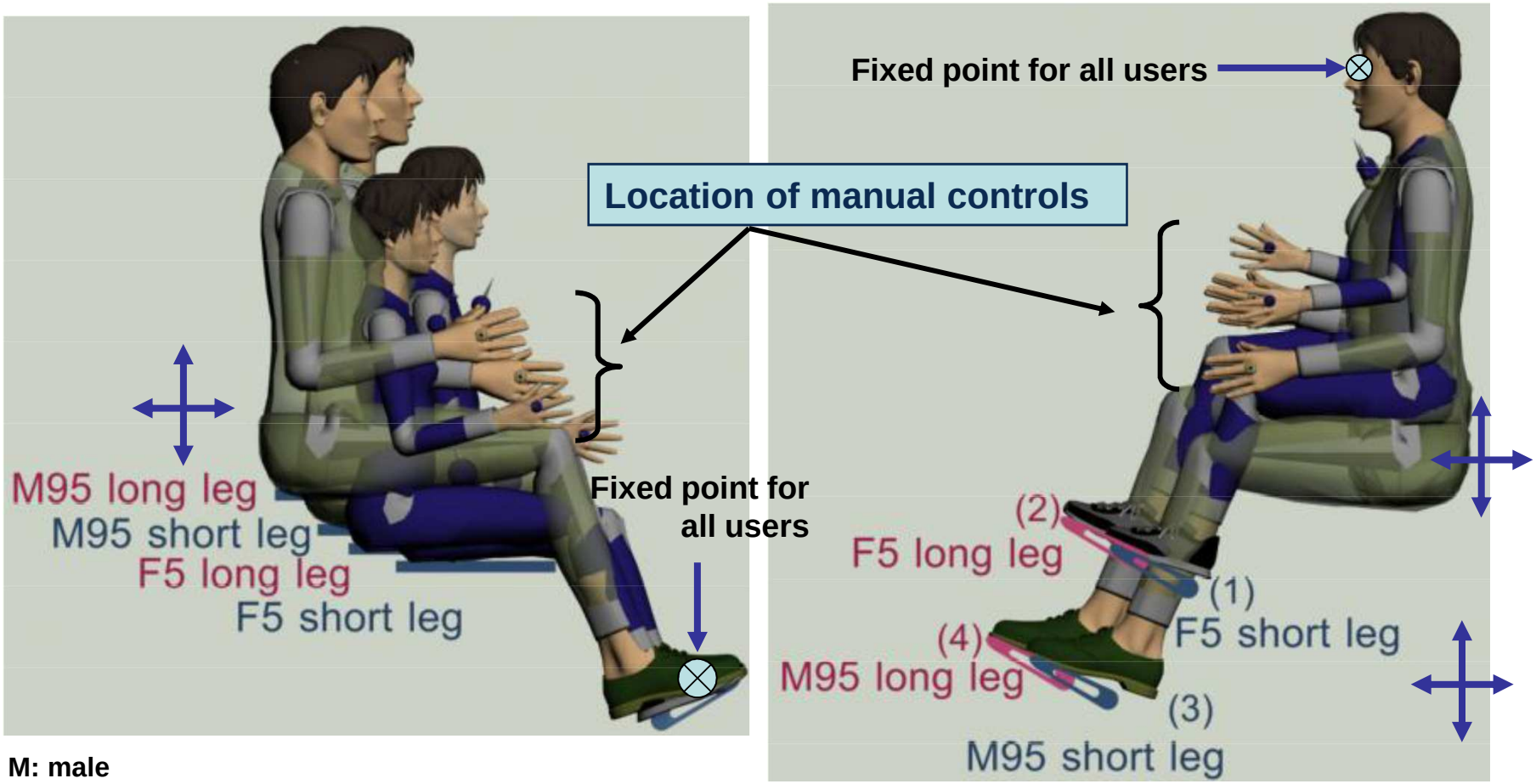


Proportion types: representative individuals

Anthropometric variance within the operator population for:

Definition of the SEAT adjustment range

Definition of the PEDAL adjustment range



M: male
F: female

Definition of the operator population

Product/workplace for a target group

Definition of all body dimensions relevant to design based upon the **particular characteristics of the target groups**

Identification of requirements from specific regulations

(e.g. limitations of body heights for pilots, range of body dimensions specified in standards for the control panel of railway tractive units)

Specification of user characteristics

- Sex
- Population group/nationality
- Stage of secular acceleration
- Age bracket
- Body height percentile

Definition of design dimensions

Identification of relevant body dimensions which determine/influence the design dimensions

- **Geometric reference point (fixing),** e.g. eye, hand
- **Anthropometric body dimension,** e.g. length of lower leg
- **Corpulence,** e.g. variance in body depth
- **Proportion (long trunk, short trunk)** e.g. eye point for F95 female + short trunk

Somatotypes

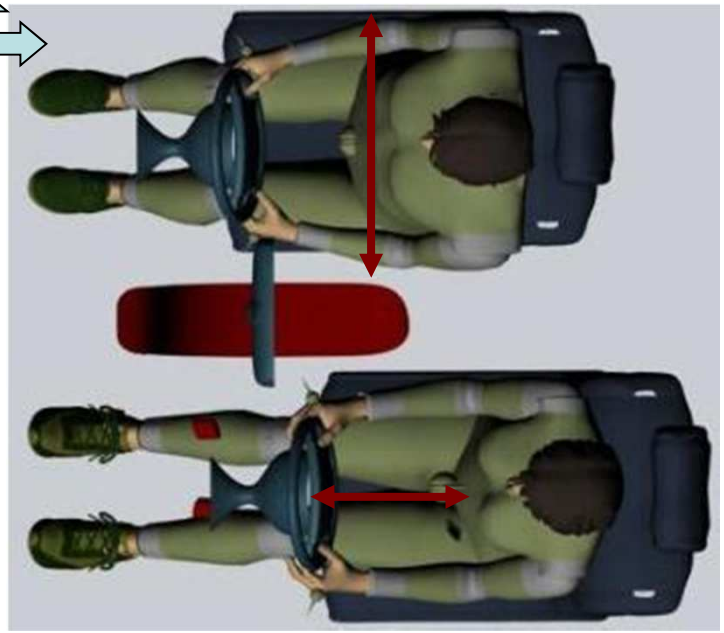
Geometric design of products in consideration of the widest anthropometric variance within the operator population:

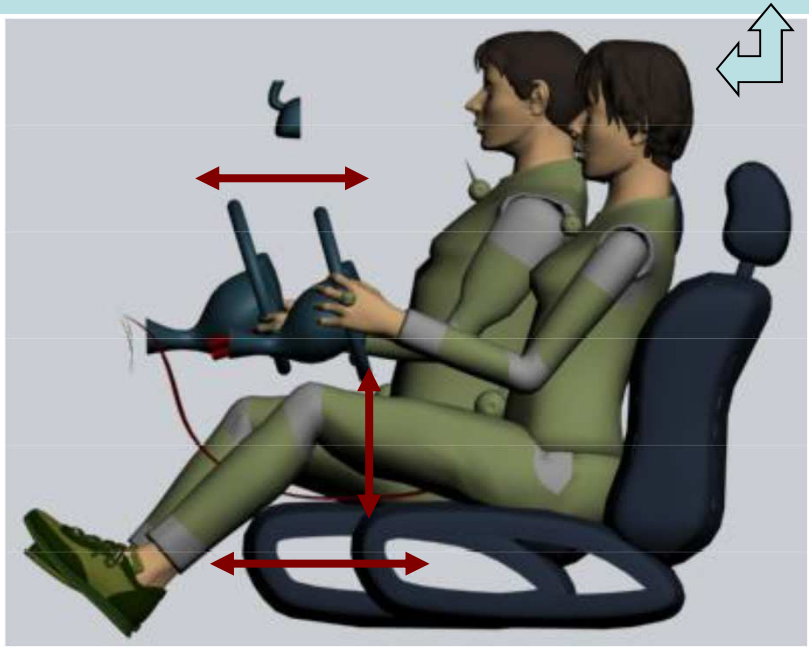
Length dimensions:

Short, corpulent, short-legged female ⇔ Tall, long-legged, slim male

Breadth, depth, circumferential dimensions:

Short, corpulent, short-legged male ⇔ Tall, slim, long-legged female





Example

Work in distribution warehouse

Important literature for Module 2-1

EN 349:2009 Safety of machinery – Minimum gaps to avoid crushing of parts of the human body

EN 547-1:2009 Safety of machinery – Human body measurements – Part 1: Principles for determining the dimensions required for openings for whole body access into machinery

EN 547-2:2009 Safety of machinery – Human body measurements – Part 2: Principles for determining the dimensions required for access openings

EN 547-3:2009 Safety of machinery – Human body measurements – Part 3: Anthropometric data

EN 614-2:2008 Safety of machinery – Ergonomic design principles – Part 2: Interactions between the design of machinery and work tasks

EN ISO 7250-1:2010 Basic human body measurements for technological design – Part 1: Body measurement definitions and landmarks

DIN 33402-1:2008 Ergonomics – Body dimensions of people – Part 1: Terms and definitions, measuring procedures

DIN 33402-2:2007 Ergonomics – Human body dimensions – Part 2: Values

DIN 33402-2 Supplement 1:2006 Human body dimensions – Part2: Values; Supplement 1: Application of body dimensions in practice

DIN 33402-3:1984 Human body dimensions – Part 3: movement room at different normal positions and movements

DIN 5566-1:2006 Railway vehicles – Driver cabs – Part 1: General requirements

DIN 5566-2:2006 Railway vehicles – Driver cabs – Part 2: Additional requirements for standards gauge railway vehicles

EN ISO 3411:2009 Earth-moving machinery – Physical dimensions of operators and minimum operator space envelope

Important literature for Module 2-1

- **DIN Taschenbuch 390** Körpermaße und Körperkräfte
- **EN ISO 15537:2005** Principles for selecting and using test persons for testing anthropometric aspects of industrial products and designs
- **Anthropologischer Datenatlas** (1986) in:
  Flügel B., Greil H., Sommer K. (1986): Anthropologischer Atlas. Grundlagen u. Daten
- **Internationaler anthropometrischer Datenatlas** (1993) in:
  Internationaler anthropometrischer Datenatlas. Bundesanstalt für Arbeitsschutz, Article 587. Wirtschaftsverlag NW, Bremerhaven. Jürgens, H. W. (1993)
- **Körpermesswerte des Europamenschen** (1998) in:
  Arbeitswissenschaftliche Erkenntnisse Nr. 108, Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, Dortmund 1998

For further standards, see **www.nora.kan.de**

Important literature for Module 2-1

International standards governing human body dimensions for machine safety

- **EN ISO 14738:2009** Safety of machinery – Anthropometric requirements for the design of workstations at machinery
- **EN ISO 7250-1:2010** Basic human body measurements for technological design – Part 1: Body measurement definitions and landmarks
- **EN 614-2:2008** Safety of machinery – Ergonomic design principles – Part2: Interactions between the design of machinery and work tasks
- **EN ISO 3411:2009** Earth-moving machinery – Physical dimensions of operators and minimum operator space envelope
- **EN 547-3:2009** Safety of machinery – Human body measurements – Part 3: Anthropometric data

Important literature for Module 2-1

- **BULLINGER, H.-J. (1994):** Ergonomie: Produkt- und Arbeitsplatzgestaltung. Stuttgart: Teubner.
- **JÜRGENS H. W.; MATZDORFF I.; WINDBERG J. (1998):** Internationale anthropometrische Daten als Voraussetzung für die Gestaltung von Arbeitsplätzen und Maschinen. 1st edition. Bremerhaven: Wirtschaftsverlag NW Verlag für neue Wissenschaft. (Arbeitswissenschaftliche Erkenntnisse, 108).
- **KIRCHNER, J.-H.; BAUM E. (1990):** Ergonomie für Konstrukteure und Arbeitsgestalter. Munich: Carl Hanser.
- **KIRCHNER, A.; KIRCHNER, J.-H.; KLIEM, M.; MÜLLER, J. M. (1990):** Räumlich-ergonomische Gestaltung: Handbuch. Bremerhaven: Wirtschaftsverlag NW (publications of the Bundesanstalt für Arbeitsmedizin und Arbeitsschutz, Article 632).
- **LANGE, W.; WINDEL, A. (12th edition, 2008):** Kleine ergonomische Datensammlung. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin.