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Basic human body measurements for technological design —

Part 3: Worldwide and regional design ranges for use in product standards

Définitions des mesures de base du corps humain pour la conception technologique —
Partie 3: Gammes de conception régionales et mondiales pour utilisation dans les normes de produits

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 159, *Ergonomics*, Subcommittee SC 3, *Anthropometry and biomechanics.*

ISO 7250 consists of the following parts, under the general title *Basic human body measurements for technological design*:

— *Part 1: Body measurement definitions and landmarks*

— *Part 2: Statistical summaries of body measurements from national populations*

— *Part 3: Worldwide and regional design values for use in ISO equipment standards*

Basic human body measurements for technological design —

Part 3: Worldwide and regional design ranges for use in product standards

1 Scope

This part of ISO 7250 provides worldwide and regional tables of design ranges for use with product standards for equipment design and safety that require ISO 7250 body measurement data input.

Anthropometric data for technological design are used and presented in many standards. However, there is currently no systematic way to update and revise those values in a timely manner, as the body sizes and variation of member body populations change with time. Further, the schedule of member body anthropometric surveys varies widely. Many industrial products are developed for regional or worldwide markets without a clear presentation of regional and worldwide ISO 7250 design ranges. Users of standards require the most appropriate body measurement values for their intended applications.

Together with ISO/TR 7250-2, which serves as a continuously updated data source for most current anthropometric data from individual member bodies, this part of ISO 7250 provides a periodically updated data source for worldwide and regional design ranges, with guidance on sex differences. This part of ISO 7250 is intended as the single source of anthropometric data for equipment design guidance in standards.

While there are sources for individual member body data in ISO/TR 7250-2, most standards do not use individual member body data for technological specification. This part of ISO 7250 is to be used whenever worldwide or regional anthropometric data are needed. In cases when there are no suitable measurements in this part of ISO 7250, the methods and justifications used in arriving at regional and worldwide values from the body measurement data of individual populations can be used with suitable measurement data.

The scope of this part of ISO 7250 is limited to the presentation of univariate design ranges of the type currently utilized in product standards (e.g. P1, P5, P95, and P99) and does not address shortcomings of using those values in multivariate designs. A separate standard on multivariate design is in preparation. In addition, this part of ISO 7250 does not address body measurements used in product standards that are not defined in ISO 7250-1. The methods used in developing this part of ISO 7250 do not take into account the population size or sampling methodology of the member bodies, so statistical values from a sparsely populated member body could set regional or worldwide upper or lower limits. The reader is referred to ISO/TR 7250-2 for details on sampling methods used in national surveys.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO/TR 7250-2, *Basic human body measurements for technological design — Part 2: Statistical summaries of body measurements from national populations*

3 Worldwide and regional design ranges

Design ranges presented in this part of ISO 7250 are directly related to ISO/TR 7250-2.

Design ranges are specified as smallest to largest 1st to 99th and 5th to 95th percentile value observed in national populations. Each percentile value in a design range comes from a single member body. Typically, product design requirements specify a smallest to largest range of values to be accommodated. However, some product standards specify medium size or midrange values, so midrange estimates are also provided here.

The worldwide ranges specified in this part of ISO 7250 are normative for product standards. However, some users of this part of 7250 may be developing products designed for a more focused, regional market. For this reason, a method is presented for creating regional design ranges from individual member body data presented in ISO/TR 7250-2. Examples of this process are shown in informative Annex A. For the anthropometric data used in deriving regional and worldwide ranges, the procedure and information for acquiring these data directly follow from the process described in ISO/TR 7250-2. The process of specifying design ranges defined in this part of ISO 7250 starts from the individual member body data presented in ISO/TR 7250-2.

Similarly, for many applications, user accommodation is maximized by considering male and female design dimensions separately. For example, maximum accommodation would be achieved by designing to a range that extends from the smallest 5th percentile value, male or female, to the largest 95th percentile value, male or female. Annex B shows the results of this procedure and should be used when the largest accommodation range is desired.

4 Procedures for establishing design ranges

4.1 Worldwide ranges

Anthropometric data are collected in many countries in the world. These anthropometric surveys vary markedly in quality, frequency, methodology, and purpose. In order to produce normative design ranges, it is critical to use anthropometric data that meet only the highest standards of representativeness and reliability. In addition, ISO standards are fundamentally a service for ISO member bodies. Therefore, the worldwide ranges presented in this part of ISO 7250 are derived from national populations of ISO member bodies presented in ISO/TR 7250-2. ISO/TR 7250-2 data are known to be consistent with ISO 7250-1 measurement definitions and protocols and ISO 15535 anthropometric database methods, and ISO/TR 7250-2 statistics have been reviewed and checked with member bodies for accuracy and reliability.

For some anthropometric dimensions, the population distribution is bi-modal by sex. This means that the male mean and female mean are separated. While the male and female distributions overlap, there are significant portions of the combined distribution that are totally male or totally female. Using a “total” 5th percentile value, therefore, may exclude 5 % of the total population but it may exclude 30 % of the female population. The effect is magnified when the sex distributions of the populations are significantly unequal, for example, in a military population which might be overwhelmingly male or in a nursing population which might be overwhelmingly female. When specific work forces are differentially male or differentially female, the “total” statistics may be significantly unrepresentative of a particular work force even if they accurately represent the national population. Using a pooled male–female population, P5 and P95 values for design for these situations will result in unequal burdens of disaccommodation between the sexes. In such cases, using separated male and female design values comes closer to achieving gender-parity in the final design.

The design ranges in Clause 5 contain male values, female values and “total” values. The sample sizes are listed so it is clear that different numbers of males and females were measured in the anthropometric surveys that are found in ISO/TR 7250-2. The sex ratios in the sample may or may not represent the sex ratios in the working age population of the member bodies contributing data. Using “total” statistics as design values may be justified in certain specific cases but in general, male and female design values

should be used separately in product or workspace design in order to ensure that both men and women are equally accommodated.

In Clause 5, the worldwide P1 value represents the smallest 1st percentile observed among all the member bodies with data presented in ISO/TR 7250-2. The worldwide P5 value represents the smallest 5th percentile observed among all the member bodies with data presented in ISO/TR 7250-2. The worldwide P95 value represents the largest 95th percentile observed among all the member bodies with data presented in ISO/TR 7250-2. The worldwide P99 value represents the largest 99th percentile observed among all the member bodies with data presented in ISO/TR 7250-2. Thus, the values in the tables are based on particular surveys and only provide estimates for particular populations. The statistical confidence in the more extreme percentiles, e.g. P1 and P99, is much lower than it is for percentiles closer to the mean.

In some cases, the smallest or largest percentile values in ISO/TR 7250-2 have been identified as either unusual or derived from body scan data not validated in accordance with ISO 20685. In such cases, a more reliable value may be chosen to set the worldwide design limit.

The midrange estimates in this part of ISO 7250 are calculated as the midpoints of the interval between the worldwide P5 and P95 estimates. The user is cautioned that these midrange estimates, while centrally located between the P5 and P95 estimates, are not equivalent to statistical medians. They may not represent medium-sized males or females in any particular population.

4.2 Regional ranges

Regional design ranges illustrated in Annex A are informative in nature. In general, regional ranges are derived from only the member body data presented in ISO/TR 7250-2. In the case of defining regional ranges for the European region, existing published CEN standards were used as a starting point and where individual European member body data in ISO/TR 7250-2 exceed the published CEN standard ranges, ISO/TR 7250-2 limits were used to form the new European regional ranges.

The regional P1 value represents the smallest 1st percentile observed among all the member bodies with data presented in ISO/TR 7250-2. The regional P5 value represents the smallest 5th percentile observed among all the member bodies with data presented in ISO/TR 7250-2. The regional P95 value represents the largest 95th percentile observed among all the member bodies with data presented in ISO/TR 7250-2. The regional P99 value represents the largest 99th percentile observed among all the member bodies with data presented in ISO/TR 7250-2.

5 Worldwide design ranges

5.1 Relationship between ISO/TR 7250-2 and this part of ISO 7250

ISO/TR 7250-2 can change at any time as new data emerge from member bodies. Unlike ISO/TR 7250-2, this part of ISO 7250 presents worldwide design ranges at a fixed point in time, reviewed periodically in accordance with ISO operating procedures. Member bodies with new anthropometric data are encouraged to submit their statistics to the Secretariat of ISO TC 159/SC 3 for inclusion in ISO/TR 7250-2.

5.2 Missing or sparse data

When suitable worldwide values are not available, the cell of the table is left blank. When data are available from only a single member body, this fact is noted in the table. When P1 and P99 values were unavailable, some member bodies have only submitted P5 and P95 values for ISO/TR 7250-2, from which the values in this part of ISO 7250 are set. Using the method described in 4.1, it is possible that the data from one member body set the P5 value, and data from another member body set the P1 value. This could occasionally cause the logical impossibility that the P1 value in this part of ISO 7250 is actually greater than the P5 value. Therefore, when such occasions arise, the P1 value has been eliminated from the design range table and noted on the table. The same situation can occur at the upper end of the distribution, with P95 and P99. In those cases also, the P99 value is eliminated.

5.3 Worldwide design range table (normative)

Table 1 presents the normative worldwide design ranges for ISO 7250-1 body dimensions. The ranges in Table 1 shall be used in product standards requiring anthropometric data.

Table 1 — Worldwide design ranges

No.	ISO 7250 Measurement			MB	N	P1	MB	N	P5	MB	N	P95	MB	N	P99	Midrange
		Age	Male	KR/NL	2613/564	18	KR	2613	19	JP	2885	63	JP	2885	65	41
			Female	KR/NL	2614/698	18	IT/KR	2011/2614	19	JP	2476	63	JP	2476	65	41
			Total	KR	5227	18	IT/KR	4021/5227	19	JP	5361	63	JP	5361	65	41
1	4.1.1	Body mass (weight) kg	Male	CN	11164	44	CN	11164	48	NL	595	117	NL	595	143	83
			Female	CN	11150	39	TH/CN	1170/11150	42	NL/US[a]	679/1261	103	US	1261	141	73
			Total	JP	5338	41	JP	5338	44	KE	207	95	KE	207	108	70
2	4.1.2	Stature (body height)	Male	KE	133	1536	TH	1246	1576	NL	563	1959	NL	563	2054	1768
			Female	IT	2011	1443	TH	1170	1467	NL	679	1799	NL	679	1864	1633
			Total	IT/JP	4021/5342	1463	JP	5342	1501	KE	207	1837	KE	207	1869	1669
3	4.1.3	Eye height	Male	CN	11164	1436	TH	1246	1462	NL	558	1842	NL	558	1916	1652
			Female	CN	11150	1337	TH	1170	1353	NL	691	1689	NL	691	1749	1521
			Total	JP	5337	1352	JP	5337	1392	KE	207	1729	KE	207	1769	1560
4	4.1.4	Shoulder height	Male	CN	11164	1244	CN	11164	1281	NL	542	1625	NL	542	1682	1453
			Female	JP	2463	1151	JP	2463	1182	KE	74	1480	NL	587	1529	1331
			Total	JP	5342	1166	JP	5342	1201	KE	207	1540	KE	207	1587	1371
5	4.1.5	Elbow height	Male	CN	11164	925	TH	1246	953	NL	562	1239	NL	562	1296	1096
			Female	KE	74	811	JP	2459	889	NL	685	1126	NL	685	1181	1008
			Total	JP	5332	874	JP	5332	903	IT	3997	1152	IT	3997	1195	1028
6	4.1.6	Iliospinal height	Male	KE	132	780	KR	2606	832	KE	132	1027	KE	132	1101	929
			Female	JP	2462	748	JP	2462	774	KE	73	970	KE	73	1017	872
			Total	KR	5219	760	JP	5341	788	KE	205	1009	KE	205	1087	899
7	4.1.7	Crotch height	Male	KR	2613	677	JP/KR	2878/2613	707	NL	588	933	NL	588	1014	820
			Female	JP	2462	621	JP	2462	645	NL	674	876	NL	674	910	761
			Total	JP	5340	632	KR	5224	659	IT	3967	899	IT	3967	935	779

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[a] Definition is different from ISO 7250-1 or substituted.

[b] Scan-extracted.

[c] 1st or 99th percentile eliminated (see text in 5.2).

Table 1 *(continued)*

No.	ISO 7250 Measurement			MB	N	P1	MB	N	P5	MB	N	P95	MB	N	P99	Midrange
8	4.1.8	Tibial height	Male	JP	2878	376	JP	2878	387	IT	1991	511	IT	1991	538	449
			Female	JP	2463	342	JP	2463	354	KE	74	490	KE	74	503	422
			Total	JP	5341	347	JP	5341	362	IT/KE	3961/206	500	IT	3961	526	431
9	4.1.9	Chest depth, standing	Male	JP	2876	[c]	TH	1246	157	DE	0	270	KE	130	316	214
			Female	IT	2004	138	JP/TH	2452/1170	149	KE	74	265	KE	74	306	207
			Total	JP	5328	143	JP	5328	153	KE	204	266	KE	204	316	209
10	4.1.10	Body depth, standing	Male	KR	2607	171	KR	2607	186	DE	0	380	KE	127	391	283
			Female	JP	2449	175	JP	2449	185	DE	0	345	KE	74	350	265
			Total	KR	5218	176	KR	5218	190	KE	201	345	KE	201	385	268
11	4.1.11	Chest breadth, standing	Male	CN	11164	242	CN	11164	253	KE	128	361	KE	128	372	307
			Female	KE	74	215	TH	1170	232	KE	74	370	KE	74	380	301
			Total	JP	5327	230	JP	5327	239	KE	202	365	KE	202	376	302
12	4.1.12	Hip breadth, standing	Male	CN	11164	273	CN	11164	282	KE	127	387	KE	127	405	334
			Female	CN	11150	275	CN	11150	290	KE	74	423	KE	74	434	357
			Total	KE	201	286	KE	201	300	KE	201	407	KE	201	431	354
13	4.2.1	Sitting height (erect)	Male	KE	132	767	KE	132	780	NL	589	1012	NL	589	1043	896
			Female	KE	74	709	KE	74	735	NL	677	943	NL	677	973	839
			Total	KE	206	721	KE	206	750	KR	5226	962	KR	5226	989	856
14	4.2.2	Eye height, sitting	Male	KE	132	647	KE	132	670	NL	594	892	NL	594	923	781
			Female	KE	74	595	KE	74	633	NL	676	830	NL	676	856	732
			Total	KE	206	611	KE	206	646	KR	5226	846	KR	5226	869	746
15	4.2.3	Cervicale height, sitting	Male	KE	127	543	KE	127	566	KR	2613	718	KR	2613	736	642
			Female	KE	74	514	KE	74	523	KR	2614	664	IT	1970	685	594
			Total	KE	201	515	KE	201	531	KR	5227	709	KR	5227	730	620

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[c] 1st or 99th percentile eliminated (see text in 5.2).

Table 1 *(continued)*

No.	ISO 7250 Measurement			MB	N	P1	MB	N	P5	MB	N	P95	MB	N	P99	Midrange
16	4.2.4	Shoulder height, sitting	Male	KE	130	500	KE	130	510	NL	590	688	NL	590	725	599
			Female	KE	74	480	KE	74	483	NL	675	642	NL	675	670	563
			Total	KE	204	480	KE	204	500	KR	5226	630	IT	3817	651	565
17	4.2.5	Elbow height, sitting	Male	KE	131	135	KE	131	148	NL	590	300	NL	590	328	224
			Female	KE	74	150	KE	74	159	NL	664	293	NL	664	321	226
			Total	KE	205	140	KE	205	150	KR	5224	292	IT	3988	312	221
18	4.2.6	Shoulder-elbow length	Male	IT	1950	277	IT	1950	288	NL	555	415	NL	555	434	352
			Female	IT	1922	259	IT	1922	270	NL	683	378	KE	74	398	324
			Total	IT	3871	262	IT	3871	275	KE	205	404	KE	205	425	340
19	4.2.7	Elbow-wrist length	Male	IT	1899	204	IT	1899	213	KE	130	338	KE	130	407	275
			Female	IT	1575	200	IT	1575	202	KE	74	314	KE	74	333	258
			Total	IT	3472	200	IT	3472	204	KE	204	330	KE	204	375	267
20	4.2.8	Shoulder (biacromial) breadth	Male	KE	127	232	KE	127	279	NL	542	456	NL	542	472	367
			Female	KE	72	254	KE	72	292	NL/US[b]	586/1257	412	US[b]	1257	429	352
			Total	KE	199	234	KE	199	284	IT	3987	425	KE	199	445	354
21	4.2.9	Shoulder (bideltoid) breadth	Male	KE	129	360	KE	129	387	US	1119	550	US	1119	592	469
			Female	CN	11150	347	TH	1170	362	KE	73	498	US	1261	555	430
			Total	IT	3989	359	IT	3989	375	KE	202	508	KE	202	544	441
22	4.2.10	Elbow-to-elbow breadth	Male	JP	2870	352	JP/CN	2870/11164	371	IT	2006	571	IT	2006	594	471
			Female	JP	2459	307	JP	2459	322	DE	0	555	IT	1998	570	439
			Total	JP	5329	314	JP	5329	332	IT	4004	558	IT	4004	578	445
23	4.2.11	Hip breath, sitting	Male	CN	11164	284	CN	11164	295	NL	589	438	US[a]	1117	483	366
			Female	IT	1995	292	TH/CN	1170/11150	310	US[a]	1259	501	US[a]	1259	557	406
			Total	IT	3984	288	IT	3984	308	KE	204	453	KE	204	472	381

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Table 1 *(continued)*

No.	ISO 7250 Measurement			MB	N	P1	MB	N	P5	MB	N	P95	MB	N	P99	Midrange
24	4.2.12	Lower leg length (popliteal height)	Male	KR	2612	347	KR	2612	365	NL	181	538	NL	181	556	452
			Female	KR	2614	318	KR	2614	333	NL	207	483	IT	1999	496	408
			Total	KR	5226	324	KR	5226	340	IT	3993	501	IT	3993	525	421
25	4.2.13	Thigh clearance	Male	CN	11164	103	CN	11164	112	KE	132	185	KE	132	196	148
			Female	IT	1998	101	IT	1998	110	KE	74	190	KE	74	241	150
			Total	IT	4001	102	IT	4001	112	KE	206	190	KE	206	200	151
26	4.2.14	Knee height	Male	JP	2868	440	JP/CN	2868/11164	456	NL	584	617	NL	584	661	537
			Female	JP	2453	405	JP	2453	418	KE	73	570	KE	73	590	494
			Total	JP	5321	410	JP	5321	427	KE	204	591	KE	204	610	509
27	4.2.15	Abdominal depth, sitting	Male	KR	2603	170	KR	2603	184	NL	181	349	NL	181	398	266
			Female	IT	1856	154	KR	2612	169	NL	207	358	NL	207	395	264
			Total	KR	5215	160	KR	5215	174	KE	204	337	KE	204	370	255
28	4.2.16	Thorax depth at the nipple	Male	KR	2613	173	TH	1246	179	KE	131	280	KE	131	294	230
			Female	CN	11150	159	CN	11150	170	KE	74	330	KE	74	369	250
			Total	JP	5326	170	JP	5326	181	KE	205	310	KE	205	335	246
29	4.2.17	Buttock - abdomen depth sitting	Male	JP	2874	172	TH	1246	181	KE	127	330	KE	127	354	256
			Female	JP	2452	160	JP	2452	173	KE	74	347	KE	74	392	260
			Total	JP	5326	164	JP	5326	177	KE	201	340	KE	201	370	259
30	4.3.1	Hand length	Male	CN	11164	164	CN	11164	170	NL	595	221	NL	595	232	196
			Female	CN	11150	154	CN	11150	159	NL	679	201	US	1260	209	180
			Total	IT/KR	3788/5224	158	KR	5224	164	KE	206	210	KE	206	218	187
31	4.3.2	Palm length perpendicular	Male	KR	2612	94	KE	131	96	JP/TH	2875/1246	123	JP	2875	127	110
			Female	KR	2614	88	DE/KR	0/2614	92	JP/KE	2455/74	114	JP	2455	118	103
			Total	KR	5226	89	KR	5226	93	JP	5330	121	JP	5330	126	107

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