

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE			
4. PERFORMING ORGANIZATION REPORT NUMBER(S)		5. MONITORING ORGANIZATION REPORT NUMBER(S) NATICK/TR-89/027	
6a. NAME OF PERFORMING ORGANIZATION Anthropology Research Project, Inc.	6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION U.S. Army Natick RD&E Center	
6c. ADDRESS (City, State, and ZIP Code) 503 Xenia Avenue Yellow Springs, Ohio 45387		7b. ADDRESS (City, State, and ZIP Code) Natick, Massachusetts 01760-5000	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable) STRNC-YBF	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER Contract DAAK60-86-C-0128	
8c. ADDRESS (City, State, and ZIP Code)		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO. 728012.12	PROJECT NO. OMA
		TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) 1988 ANTHROPOMETRIC SURVEY OF U.S. ARMY PERSONNEL: SUMMARY STATISTICS INTERIM REPORT			
12. PERSONAL AUTHOR(S) Claire C. Gordon*, Thomas Churchill, Charles E. Clauser, Bruce Bradtmiller, John T. McConville, Ilse Tebbetts and Robert A. Walker*			
13a. TYPE OF REPORT Interim	13b. TIME COVERED FROM 3 Aug 87 TO 24 Mar 89	14. DATE OF REPORT (Year, Month, Day) 1989 March 30	15. PAGE COUNT 336
16. SUPPLEMENTARY NOTATION *Affiliated with Science and Advanced Technology Directorate, U.S. Army Natick Research, Development and Engineering Center			
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number) ANTHROPOMETRY HUMAN BODY SIZE MEN ANTHROPOMETRIC SURVEY MEASUREMENTS WOMEN ANTHROPOMETRIC DATA DIMENSIONS ARMY
FIELD	GROUP	SUB-GROUP	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) Results of the 1987-1988 anthropometric survey of Army personnel are presented in this report in the form of summary statistics and percentile data. These anthropometric data are presented for a subset of personnel (1774 men and 2208 women) sampled to match the proportions of age categories and racial/ethnic groups found in the active duty Army of June, 1988. Dimensions included in this report include 132 standard measurements made in the course of the survey, 60 derived dimensions calculated largely by adding and subtracting standard measurement data, and 48 head and face dimensions reported in traditional linear terms but collected by means of an automated headboard designed to obtain three-dimensional data. Measurement descriptions, visual indices, and a glossary of terms are included to help identify and locate dimensions.			
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL Dr. Claire C. Gordon		22b. TELEPHONE (Include Area Code) 508-651-5429	22c. OFFICE SYMBOL STRNC-YBF

PREFACE

This interim report begins the process of reporting on the results of the U.S. Army Anthropometric Survey (ANSUR) of 1987-1988. The survey was among the most ambitious ever undertaken; a measuring team of 22 persons spent nearly a year collecting data on some 25,000 screened subjects and close to 9,000 measured subjects at 11 Army bases. A similarly ambitious reporting phase is anticipated with this, the first of the reports to be issued on the survey data. Its primary purpose is to release survey summary statistics in a timely manner so that designers, patternmakers, and other users within the U.S. Army, and beyond, can begin incorporating these data into their designs as quickly as possible. A more complete report of the survey summary statistics, to be issued in the months ahead, will also include more textual material.

A project of this scope could not have been completed without the help of numerous military and civilian personnel.

Successful execution of a complex sampling strategy and acquisition of the largest anthropometric data set ever collected by the Army would have been impossible had it not been for the full and active support received from GEN Carl Vuono, Army Chief of Staff, GEN Joseph Palastra, Commander of the Army Forces Command, GEN Maxwell Thurman, Commander of the Army Training & Doctrine Command (TRADOC), and GEN Louis Wagner, Commander of the Army Materiel Command.

From the U.S. Army Troop Support Command, we thank MG John E. Long, MG Henry G. Skeen (retired), BG Charles E. St. Arnaud, and BG Leo J. Pigaty for their personal encouragement and active support of ANSUR during its planning, coordination, and execution.

We also thank the command groups and staffs of the following organizations which provided test subjects despite their heavy mission commitments: the U.S. Army Health Services Command, I Corps, III Corps, the XVIII Airborne Corps, the U.S. Army Chemical School, the U.S. Army Military Police School, the U.S. Army Signal Center, the U.S. Army Aviation Center, the U.S. Army Training Center at Ft. Jackson, and the U.S. Training Center at Ft. Dix. Within each of these organizations were liaison officers and noncommissioned officers responsible for coordination of all the logistic details needed to actually execute the survey at each of the host installations. These liaison personnel made the successful execution of a difficult project possible: MAJ John Roper and CPT Raphael Deegan, Ft. McClellan; MAJ Lawrence Hall and SFC Norman Homan, Ft. Campbell; COL Robert Smoot and SGM Walter Taylor, Ft. Bragg; CPT Joel Weeks, Ft. Stewart; CPT Michael Robinson, Ft. Ord; LTC James Gildersleeve, MAJ Marguerite Campbell and CPT Joseph Dirac, Defense Language Institute; MAJ James Taylor, Ft. Lewis; MAJ James R. Sisson and MAJ Arne W. Owens, Ft. Hood; LTC Dees Stallings, Ft. Gordon; CPT Mark Becker, Ft. Jackson; COL James B. Sauer and CPT Anthony Shannon, Ft. Rucker; MAJ Dale E. Graham and CPT George Trotter, Ft. Dix.

Special thanks are owed to Mr. Ignatius Stefaniw, LTC David Kidroske, and CPT Betty M. Gieseke of the U.S. Army Training & Doctrine Command for their patient and persistent support in the selection and coordination of TRADOC installations for participation in ANSUR.

Within the U.S. Army Natick Research, Development and Engineering Center we gratefully acknowledge the guidance and support received from COL Clinton A. Hodder, COL A.D. Rodgers III, Dr. Robert Lewis, Mr. Edward Levell, Dr. Abner Salant, Dr. Herbert Meiselman, Dr. Lawrence Symington, Mr. Charles Williams, and Dr. Carolyn Bensel. These individuals were instrumental in the planning, funding, and execution of ANSUR.

Also at Natick, LTC Stanley Holgate served as senior liaison officer for ANSUR. LTC Holgate's planning of feasible approaches to subject acquisition and his coordination of the acquisition of both facilities and subjects at each ANSUR post were critical to the success of this project. Ms. Beth Ann Holloway, in the capacity of 1LT, served as the Officer in Charge (OIC) at each post and the primary Natick military liaison in LTC Holgate's absence. In her role as OIC, Ms. Holloway kept day-to-day operations functioning smoothly and efficiently.

The data reported in this manuscript were collected by a specially recruited and trained measuring team, who, throughout a year of fieldwork, maintained the highest of professional standards. Ms. Jeryl Neff, the team leader, was responsible for overseeing data collection quality and for the maintenance of crew morale and professionalism. Field crew members, in alphabetical order, were: Donna Acton, Scott Anspach, Gary Ball, Karen Ball, Cindy Blackwell, Mary Bloom, Jeffery Bonner, John Crafts, Lee Gasaway, Lori Hedberg, Mike Herzing, Chuck Janini, Julie Janini, Anne Kaminski, Sara Kelly, Shirley Kristensen, Lisa Love, Jill Parks, Lisa Prenger, Amy Pulse, Lisa Richards, Robyn Tebbetts, Timi Trawick, and Phillip Walker.

Invaluable editorial comments were made on this manuscript by Ms. Marcia Lightbody, Natick Technical Editor, and Drs. Carolyn Bensel and Kenneth Parham of the Materiel Systems Human Factors Branch, Behavioral Sciences Division, Science and Advanced Technology Directorate.

Finally, the authors would like to acknowledge the care and attention devoted to the production of this report by staff members at Anthropology Research Project: Jane Reese, Belva Hodge, Lori Deen, and Phillip Walker. Alice McKinney of alicemckinney graphics prepared the visual indexes. To all of these talented individuals, the authors express their sincere appreciation.

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1987-1988 ANTHROPOMETRIC SURVEY OF U.S. ARMY PERSONNEL:
SUMMARY STATISTICS INTERIM REPORT

CHAPTER I

INTRODUCTION

All U.S. military and many foreign services compile and maintain extensive collections of body-size information used primarily to guide the design and sizing of clothing, personal protective equipment, work stations, and computer-generated human models. In order to be effective, such a data base must be updated periodically to accurately reflect the body sizes and proportions of the military population it purports to represent.

The last anthropometric survey of U.S. Army men was conducted in 1966,¹ some 22 years or the equivalent of a military generation ago. A substantial proportion of the sample was young (88% were under 25 years old), and some 78% of the subjects were White. By comparison, only 44% of today's male soldiers are under 25, and 66% are White.² Blacks represent 25% of Army men today,² as compared to 15% in the 1966 survey.

The most recent body size survey of U.S. Army women was conducted in 1977³ and, while more current than the male survey, is characterized by considerably greater differences in racial composition. Three-quarters of the 1977 survey subjects were White, and slightly less than one quarter were Black. Black women comprise more than 40% of today's Army, Whites slightly more than half.² The majority of today's Army women are aged 25 and over;² in the 1977 survey more than half were 25 and under.

Between 1970 and 1980, the percentage of women in the Army increased nearly sevenfold from 1.46% to 9.85%. Today, women make up 10.88% of Army personnel,² and with each passing year, more jobs are filled by women. This means that clothing, protective equipment, and workspaces, originally sized and designed to accommodate males only, must be modified and redesigned to accommodate the larger variations represented by an integrated male/female population.

It was apparent in the mid-80s that the Army's anthropometric data base had serious deficiencies that limited its applicability for current and future sizing, design, and procurement.⁴ A comprehensive body-size study of U.S. Army men and women was undertaken in 1987-1988 to correct these deficiencies. The goals of the survey were to acquire a large body of data from comparably measured males and females to serve the Army's current design and engineering needs, as well as those anticipated for several decades into the future.

A number of new and improved methodologies in the areas of sampling, instrumentation, and verification were utilized. These included: a complex sampling plan designed to produce a data base that can be adapted to changing population demographics; simultaneous collection and processing of male and female data for the creation of an integrated data base; the use of portable computers for data entry and first-level editing in the field;⁵ and the development and use of new measuring devices for the collection of head and hand data.^{6,7}

A year of planning preceded the survey. During this time, hundreds of candidate dimensions were sifted to arrive at the final selection^{8,9} which included 132 directly measured dimensions, and three-dimensional coordinates on 26 points of the head and face. Summary statistics for these dimensions, as well as an additional 60 derived dimensions, are reported in this volume. Over 8,000 hand photos were also taken as a permanent resource for future needs.

Although nearly 9,000 subjects were fully measured, several age and race categories were deliberately oversampled as a bankable resource to draw upon, should the proportion of these groups change in future years. Thus, the fully measured survey sample was further winnowed to carve out a working data base which reflects the proportions of men and women in various racial/ethnic and age groups found in today's Army.² It is this set of 1,774 men and 2,208 women--the working data base--whose measurement data appear in this interim report.

Tables 1, 2, and 3 outline the age and racial/ethnic distributions of male and female subjects in the working data base. Some 66.1% of the men in the working data base are White, 25.8% are Black, 3.8% are Hispanic, and the remaining 4.3% represent other racial/ethnic groups including Asians, Pacific Islanders, Native Americans, and others. Older subjects outnumber younger ones among the men, with 540 (30.4%) aged 31 and over, 448 (25.2%) between 25 and 30, 474 (26.6%) between 21 and 24, and 312 (17.6%) aged 20 and under.

Among the women, 51.6% of the subjects are White, 41.8% are Black, 2.6% are Hispanic, and 3.9% are divided among the other racial/ethnic groups. Some 480 (21.7%) female subjects are aged 31 and over, 706 (32.0%) are between 25 and 30, 659 (29.8%) are between 21 and 24, and 363 (16.4%) are aged 20 and under.

Included in this report are landmark and measurement descriptions, summary statistics and percentiles, and visual indices designed to help the user identify and locate dimensions of interest. A final report, currently in preparation, will provide additional information on: the sampling strategy; selection and use of survey dimensions; survey procedures; descriptions of instruments; illustrations of all landmarks, measurements, and instruments; and additional data, including frequency distributions of the measurement data and tabular demographic statistics describing the survey sample.

The working data in this report are given in Chapters III, IV, and V devoted to summary statistics and descriptions of the standard dimensions, the derived dimensions, and the headboard measurements, respectively. The landmarks used to define the origin and termination of the measurements made in this survey are listed and briefly described in Chapter II.

TABLE 1. Age Distribution of Subjects
in the Working Data Base.

Females				Males			
Age	Frequency	Percent	Cumulative Percent	Age	Frequency	Percent	Cumulative Percent
17	0	.0	.0	17	1	.1	.1
18	47	2.1	2.1	18	27	1.5	1.6
19	132	6.0	8.1	19	128	7.2	8.8
20	184	8.3	16.4	20	156	8.8	17.6
21	155	7.0	23.5	21	133	7.5	25.1
22	149	6.7	30.2	22	141	7.9	33.0
23	176	8.0	38.2	23	98	5.5	38.6
24	179	8.1	46.3	24	102	5.7	44.3
25	151	6.8	53.1	25	100	5.6	49.9
26	142	6.4	59.6	26	94	5.3	55.2
27	133	6.0	65.6	27	65	3.7	58.9
28	103	4.7	70.2	28	70	3.9	62.9
29	103	4.7	74.9	29	59	3.3	66.2
30	74	3.4	78.3	30	60	3.4	69.6
31	64	2.9	81.2	31	61	3.4	73.0
32	82	3.7	84.9	32	56	3.2	76.2
33	64	2.9	87.8	33	62	3.5	79.7
34	62	2.8	90.6	34	42	2.4	82.0
35	41	1.9	92.4	35	51	2.9	84.9
36	43	1.9	94.4	36	44	2.5	87.4
37	33	1.5	95.9	37	42	2.4	89.7
38	19	.9	96.7	38	42	2.4	92.1
39	13	.6	97.3	39	36	2.0	94.1
40	19	.9	98.2	40	29	1.6	95.8
41	13	.6	98.8	41	28	1.6	97.4
42	5	.2	99.0	42	15	.8	98.2
43	4	.2	99.2	43	9	.5	98.7
44	5	.2	99.4	44	8	.5	99.2
45	4	.2	99.6	45	4	.2	99.4
46	4	.2	99.8	46	4	.2	99.6
47	2	.1	99.9	47	2	.1	99.7
48	1	.0	99.9	48	4	.2	99.9
49	1	.0	100.0	49	0	.0	99.9
50	1	.0	100.0	50	0	.0	99.9
51	0	.0	100.0	51	1	.1	100.0
TOTALS	2,208	99.9	100.0		1,774	99.9	100.0

TABLE 2. Racial/Ethnic Distribution of Subjects
in the Working Data Base.

<u>Race</u>	<u>Females</u>			<u>Race</u>	<u>Males</u>		
	<u>Frequency</u>	<u>Percent</u>	<u>Cumulative Percent</u>		<u>Frequency</u>	<u>Percent</u>	<u>Cumulative Percent</u>
White	1140	51.6	51.6	White	1172	66.1	66.1
Black	922	41.8	93.4	Black	458	25.8	91.9
Hispanic	58	2.6	96.0	Hispanic	68	3.8	95.7
Asian/Pacific	32	1.4	97.5	Asian/Pacific	28	1.6	97.3
American Indian	14	.6	98.1	American Indian	12	.7	98.0
Mixed/Other	42	1.9	100.0	Mixed/Other	36	2.0	100.0
TOTALS	2,208	99.9	100.0		1,774	100.0	100.0

TABLE 3. Percentage of Working Data Base Subjects
by Age and Racial/Ethnic Category.

<u>Age (yrs)</u>	<u>MALES</u>					
	<u>White</u>	<u>Black</u>	<u>Hispanic</u>	<u>Asian/ Pacific Island</u>	<u>American Indian/ Alaskan Native</u>	<u>Other</u>
≤ 20	12.63	3.78	0.56	0.23	0.11	0.28
21-24	17.93	6.93	0.90	0.34	0.11	0.51
25-30	15.39	7.67	1.07	0.39	0.11	0.62
≥ 31	20.12	7.44	1.30	0.62	0.34	0.62
	<u>FEMALES</u>					
≤ 20	9.47	5.89	0.45	0.23	0.14	0.27
21-24	15.44	12.50	0.72	0.36	0.23	0.59
25-30	15.04	14.99	0.82	0.41	0.14	0.59
≥ 31	11.68	8.38	0.63	0.45	0.14	0.45

CHAPTER II

THE LANDMARKS

Dimensions are measured from one point on the body (or a fixed surface such as the floor) to another or, in the case of circumferences, around a part of the body at a specified level. To ensure that each dimension is measured accurately and consistently from subject to subject, dimensions are defined in terms of body landmarks, which serve as the origin, termination, or level of measurement of a dimension.

Two men and two women were trained in locating many of these points by palpation or by sight, and placing actual drawn marks on the bodies of all subjects in this survey. Measurers were also trained to recognize other easily located landmarks such as Dactylion II, the tip of the index finger, for which marking was not necessary.

The landmarks used to define the measurements in the survey are listed and briefly described below. Detailed illustrated instructions for locating these landmarks can be found in the Measurer's Handbook.¹⁰

Abdominal point, anterior

The most protruding point of the relaxed abdomen of a seated subject.

Acromion, right and left

The point of intersection of the lateral border of the acromial process and a line running down the middle of the shoulder from the neck to the tip of the shoulder.

Acropodion

The tip of the first or second toe, whichever is longer.

Alare, right and left

The lateral point on the flare or wing of the nose.

Anterior superior iliac spine, right and left

The anterior points of the right and left iliac crests.

Axillary fold, posterior: right and left

The highest points of the right and left axillary folds on the back.

Biceps point

The highest point of the right flexed biceps as viewed from the subject's right side.

Bustpoint, right and left

The anterior points of the bra cups.

Buttock point, posterior

Point of maximum protrusion of the right buttock of a standing subject.

Buttock point, right lateral and left lateral

Points on the thigh or hip at the level of the maximum protrusion of the right buttock.

Calf

A point on the side of the calf at the level of the maximum circumference of the right calf.

Cervicale

The superior palpable point of the spine of the seventh cervical vertebra.

Cheilion, right and left

The lateral point of the juncture of the fleshy tissue of the lips with the facial skin at the corner of the mouth.

Chin

The most protruding point on the bottom edge of the chin along the jawline.

Clavicle point, right and left

The superior points of the lateral ends of the clavicles.

Crinion

The lowest point of the hairline on the forehead in the midsagittal plane.

Dactylion II

The tip of the index finger.

Dactylion III, right and left

The tip of the middle finger.

Deltoid point, right and left

The lateral point of the right deltoid muscle and the margin of the left deltoid muscle at the level of the right deltoid point.

Dorsal juncture of the calf and thigh

The juncture between the right calf and thigh behind the knee of a subject sitting with the knee flexed 90 degrees.

Dorsal juncture of the foot and leg

The top of a skin crease between the foot and the front of the ankle when the knees and ankles are flexed about 30 degrees.

Ear, bottom

The lowest point of the ear on its long axis.

Ear point

The lateral point (farthest from the head) of the right ear.

Ear, top

The highest point of the ear on its long axis.

Ectocanthus

The outside corner of the right eye formed by the meeting of the upper and lower eyelids.

Ectoorbitale

The posterior point on the frontal process of the zygomatic bone at the level of the outer corner of the eye.

Elbow crease

The skin crease on the inside of the elbow joint when the elbow is flexed 90 degrees.

Fifth metatarsophalangeal protrusion

The lateral protrusion of the right foot in the region of the fifth metatarsophalangeal joint.

First metatarsophalangeal protrusion

The medial protrusion of the right foot in the region of the first metatarsophalangeal joint.

Frontotemporale, right and left

The point of deepest indentation of the temporal crest of the frontal bone above the browridges.

Glabella

The anterior point on the frontal bone midway between the bony browridges.

Gluteal furrow point

The lowest point of the lowest furrow or crease at the juncture of the right buttock and the thigh.

Gonion

The lateral point on the posterior angle of the mandible (jawbone).

Heel point, lateral and medial

The lateral and medial points of the right heel located at or behind the most protruding point of the lateral malleolus (outside ankle bone).

Iliocristale

The highest palpable point of the right iliac crest of the pelvis, one half the distance between the anterior superior iliac and posterior superior iliac spines.

Inferior breast point

The inferior point of the juncture of the lower of the two breasts with the torso.

Infraorbitale

The lowest point on the anterior border of the bony eye socket.

Infrathyroid

The inferior point in the midsagittal plane of the thyroid cartilage (Adam's apple).

Inner thigh

A vertical line halfway between the front and back of the right inner thigh, and extending downward from the level of the gluteal furrow.

Knee point, anterior

The most protruding point of the right kneecap of a seated subject.

Lateral femoral epicondyle, standing and sitting

Lateral point of the right femoral epicondyle (knee pivot point).

Lateral malleolus

The lateral point of the right lateral malleolus (outside ankle bone).

Medial malleolus

The medial point of the medial malleolus (inside ankle bone).

Menton

The inferior point of the mandible in the midsagittal plane (bottom of the chin).

Metacarpale II

The lateral point of the right metacarpophalangeal joint II (at the base of the index finger on the outer edge of the hand).

Metacarpale V

The medial point of the right metacarpophalangeal joint V (at the base of the little finger on the outer edge of the hand).

Midpatella

The anterior point halfway between the top and bottom of the right patella (the kneecap).

Midshoulder

The point on top of the right shoulder midway between the neck (right trapezius point) and the tip of the shoulder (acromion, right).

Midspine

A line down the center of the back.

Neck: anterior, right lateral, and left lateral

Anterior and lateral points at the base of the neck.

Olecranon, bottom and rear

The lowest and rearmost points of the elbow with the elbow flexed 90 degrees.

Olecranon, center

A point on the center of the curvature of the right olecranon process with the elbow flexed about 115 degrees.

Otopasion superior

The anterior superior point of the juncture between the right ear and the head.

Posterior superior iliac spine

The posterior point of the crest of the right ilium. A dimple normally overlies this point.

Promenton

The anterior projection of the soft tissue of the chin.

Pronasale

The point of the anterior projection of the tip of the nose.

Pternion

The posterior point of the right heel.

Radiale

The highest point on the outside edge of the radius.

Scye

Points on the upper arm and torso associated with the armhole of a garment. These landmarks were drawn with the subject standing erect and the arms relaxed at the sides:

Anterior scye on the torso: A short horizontal line on the torso originating at the apex of the anterior axillary fold.

Anterior scye on the upper arm: A short horizontal line on the upper arm originating at the apex of the anterior axillary fold.

Posterior horizontal scye, right and left: A short horizontal line on the back originating at the apex of the posterior axillary fold.

Posterior vertical scye, right and left: A short vertical line originating at the apex of the posterior axillary fold.

Posterior diagonal scye, right and left: A diagonal line connecting the apex of the posterior axillary fold with the **acromion** landmarks on the tip of the shoulder.

Midsycye, right and left: A short horizontal line bisecting the **posterior diagonal scye** landmark.

Scye level at midspine: A short horizontal line across the spine at the level of the **posterior horizontal scye** landmarks.

Sellion

The point of the deepest depression of the nasal bones at the top of the nose.

Stomion

The point of intersection of the upper and lower lip in the midsagittal plane when the mouth is closed.

Stylian

The lowest point of the bottom of the radius.

Submandibular

The juncture, in the midsagittal plane, of the lower jaw (mandible) and the neck.

Subnasale

The point of intersection of the philtrum (groove of the upper lip) with the inferior surface of the nose in the midsagittal plane.

Suprapatella

The superior point of the patella (kneecap).

Suprasternale

The inferior point of the jugular notch of the sternum (top of the breastbone).

Tenth rib

The inferior point of the right tenth rib (bottom of the rib cage).

Thelion, right and left

Center of the nipple (on males).

Thigh point, top

The highest point of the top of the right thigh of a seated subject (in measuring THIGH CLEARANCE).

Thumbtip

The tip of the right thumb.

Top of head

The highest point on the head when the head is in the Frankfort plane.

Tragion, right and left

The superior point on the juncture of the cartilaginous flap (tragus) of the ear with the head.

Trapezius point, right and left

The point at which the anterior border of the trapezius muscle crosses the lateral neck landmark.

Trochanter

A point at the center of the lateral surface of the greater trochanter of the right femur of a sitting subject.

Trochanterion

The superior point of the greater trochanter of the right femur of a standing subject.

Waist (natural indentation): right and left; anterior and posterior

The point of greatest indentation on the profile of the right side of the torso as viewed from the front of the subject, or one-half the distance between the **tenth rib** and the **iliocristale** landmarks if no indentation is present.

Waist (omphalion): right and left; anterior and posterior

Level of the center of the navel.

Wrist, dorsal

A line across the back of the wrist originating at the stylium landmark and perpendicular to the long axis of the arm.

Zygion, right and left

The lateral point on the zygomatic arch.

Zygofrontale, right and left

The lateral point of the frontal bone on its zygomatic process.

CHAPTER III

THE STANDARD MEASUREMENTS

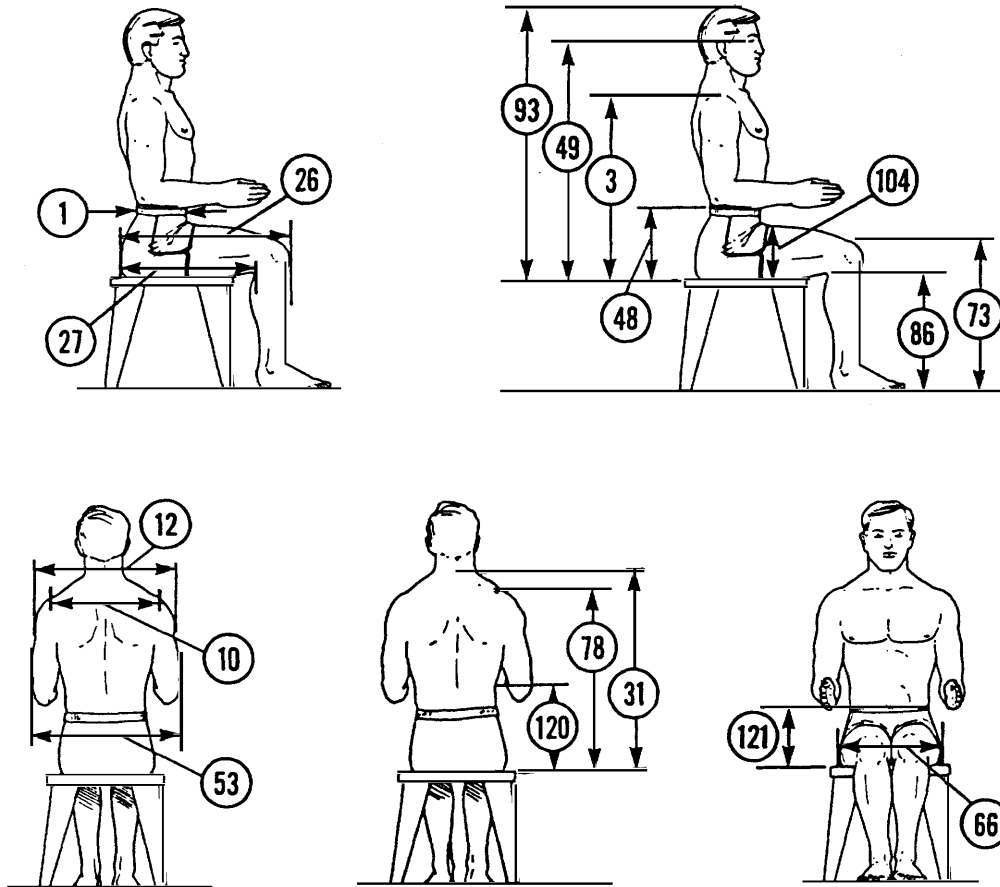
One hundred thirty-two directly measured dimensions were obtained in this survey using traditional measuring instruments and methods. Where there was a choice of right or left, all measurements were taken on the right side unless otherwise specified or in the rare cases where an injury or anatomical abnormality made it necessary to measure on the left side. All measurements were made to the nearest millimeter. Weight was taken to the nearest 0.1 kilogram. Detailed illustrated instructions for making these measurements can be found in the Measurer's Handbook.¹⁰

Summary statistics, including means, standard deviations, and percentile values for male and female subjects are tabulated on the ensuing pages. Users of these data will note .00 standard error (SE) values for some means and standard deviations. This occurs because values in these tables are not listed beyond two decimal places. It will also be noted that for crinion and interpupillary measurements the numbers of subjects are slightly below 2,208 females and 1,774 males. Crinion (the widow's peak) cannot be located on bald subjects or those with receding hairlines; thus measurements involving this landmark were not taken on some subjects.

In the case of INTERPUPILLARY BREADTH, the eyes of a few subjects were too close together or too far apart to be accommodated by the device used to measure this variable. There are four missing values (three male and one female) for INTERPUPILLARY BREADTH. These result from a limitation in the range of the pupillometer, which was capable of measuring from 52 mm to 76 mm. Two additional females have missing data due to medical conditions which prevented the measurement of INTERPUPILLARY BREADTH. The three males had an INTERPUPILLARY BREADTH which was larger than 76 mm, and the female had a value which was smaller than 52 mm. One male had a measured value of 78 mm, but this was measured in the traditional way, using a sliding caliper. This subject's value is recorded as 78 mm and is not considered missing. Nonmeasurable (i.e. missing) values at the ends of the distribution have a predictable effect on the summary statistics. The calculated female mean will be larger than the true mean, while the calculated male mean will be smaller than the true mean. The calculated standard deviation and variance for both sexes will be smaller than the true standard deviation and variance. The calculated female 1st percentile will be greater than the true 1st percentile, and the calculated male 99th percentile will be smaller than the true 99th percentile. Because the number of those missing is so small, however, the magnitude of these differences is quite small. In order to get an estimate of the magnitude, we recalculated the summary statistics after substituting 80 mm (the upper limit of the instrument plus one standard deviation) for the male missing values and 48 mm (the lower limit of the instrument minus one standard deviation) for the female missing value. The male mean increased by 0.02 mm, and the standard deviation by 0.05 mm. The percentiles were unchanged. The female mean decreased by 0.01 mm, while the standard deviation increased by 0.01 mm. The 1st percentile was decreased by 1 mm, but the remaining percentiles were unchanged. The practical effects of the limited range of the pupillometer are thus inconsequential.

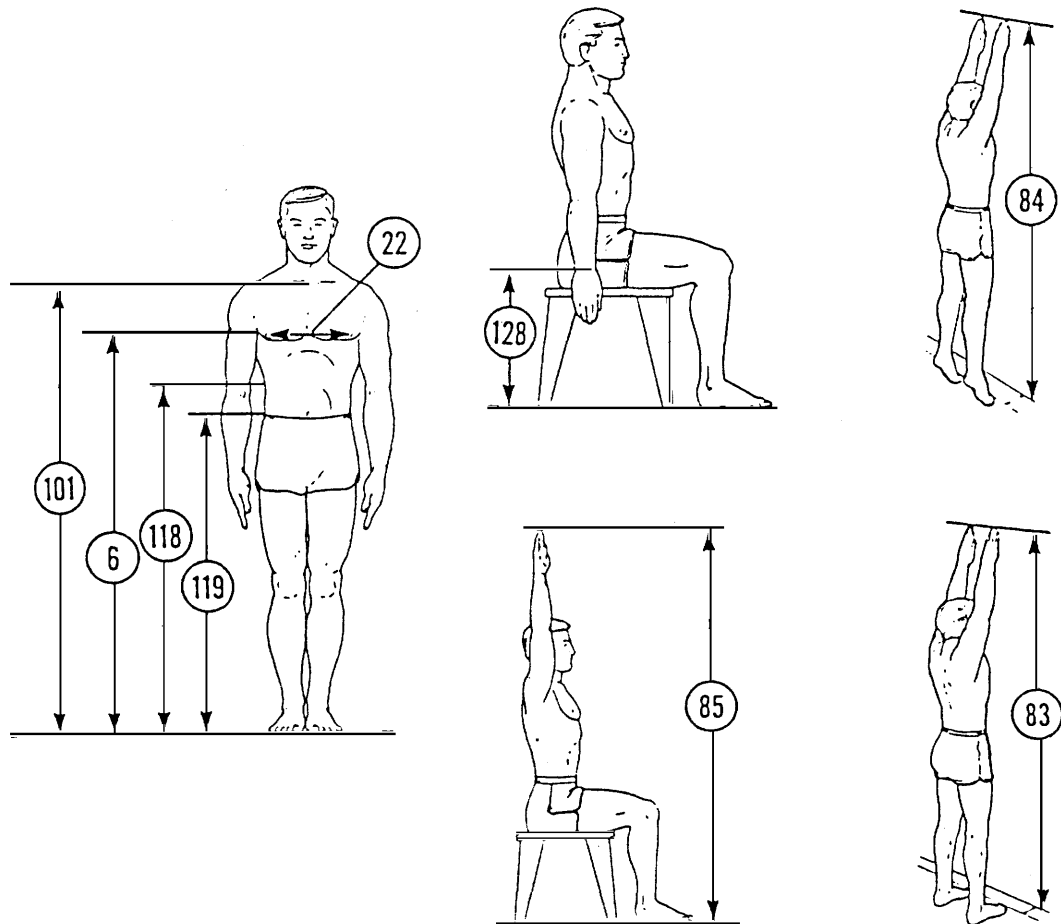
A visual index, designed to assist the reader in locating particular dimensions whose names may be unfamiliar, appears on the following pages. Completing this section are brief measurement descriptions (page 24) and the summary statistics (page 47).

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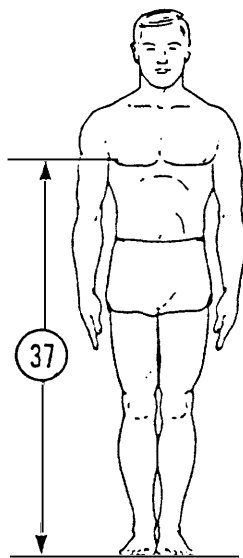
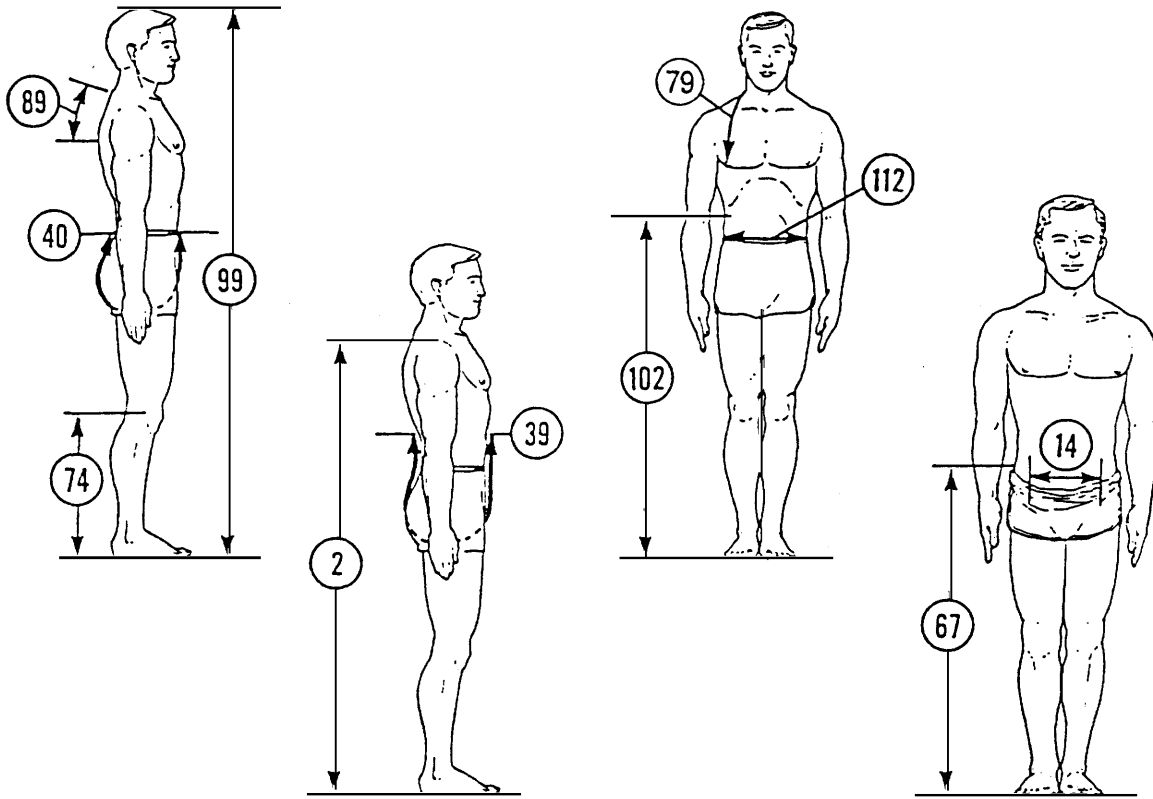
- | | |
|---|--|
| (1) ABDOMINAL EXTENSION DEPTH,
SITTING | (66) HIP BREADTH, SITTING |
| (3) ACROMIAL HEIGHT, SITTING | (73) KNEE HEIGHT, SITTING |
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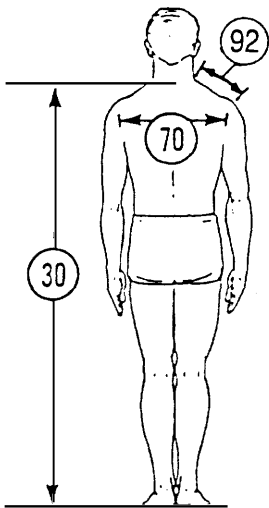
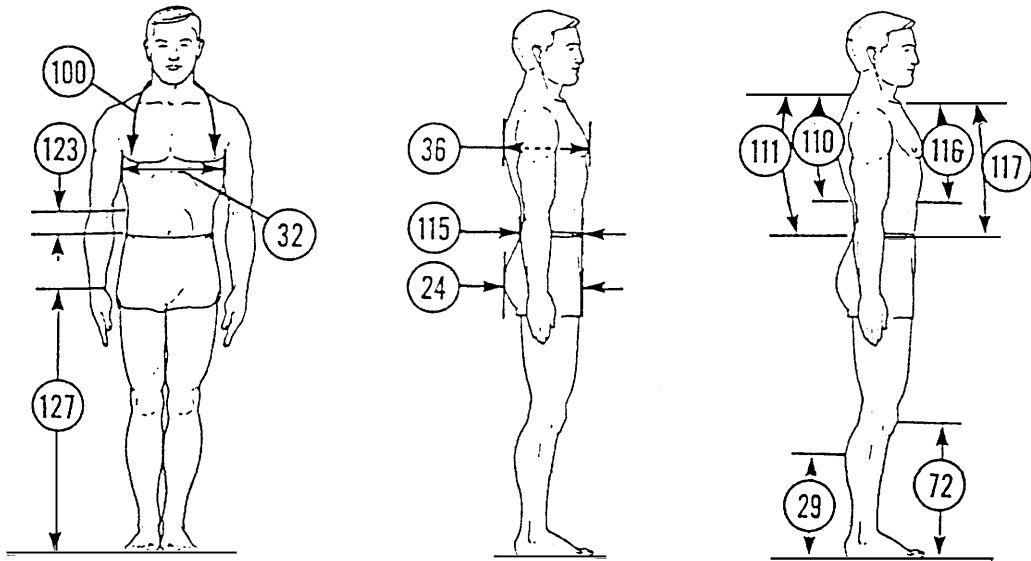
- (6) AXILLA HEIGHT
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- (84) OVERHEAD FINGERTIP REACH, EXTENDED
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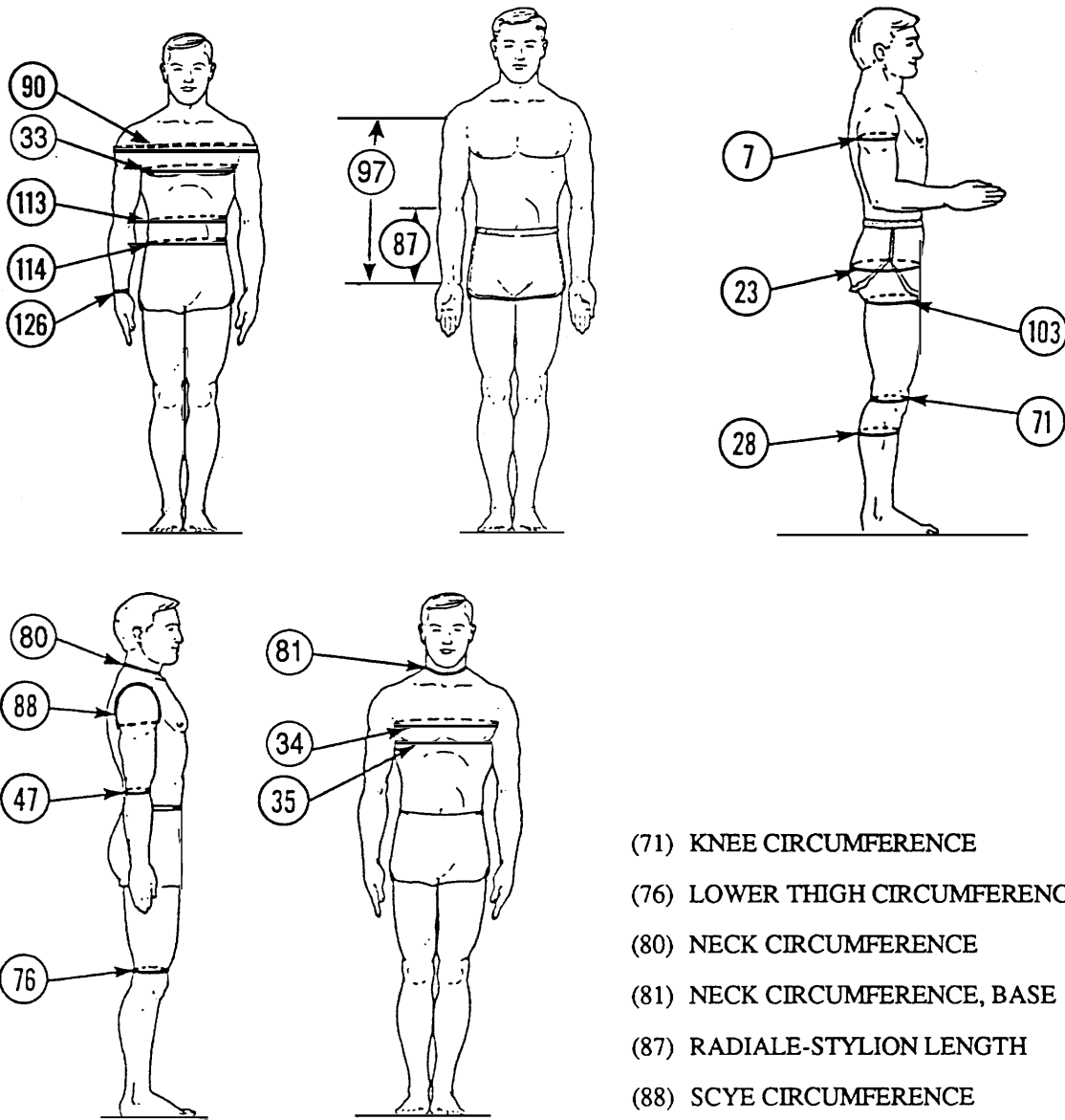
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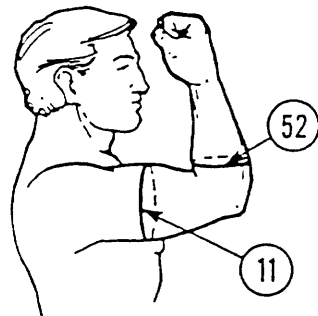
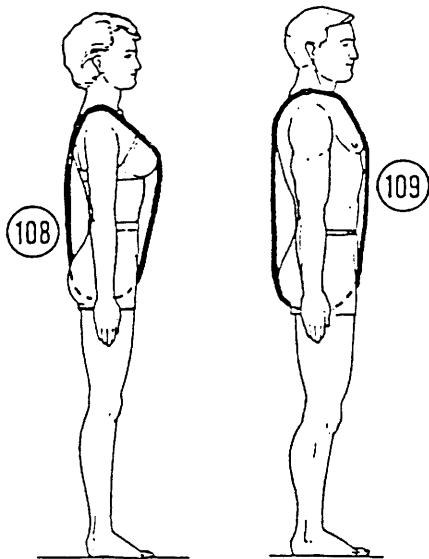
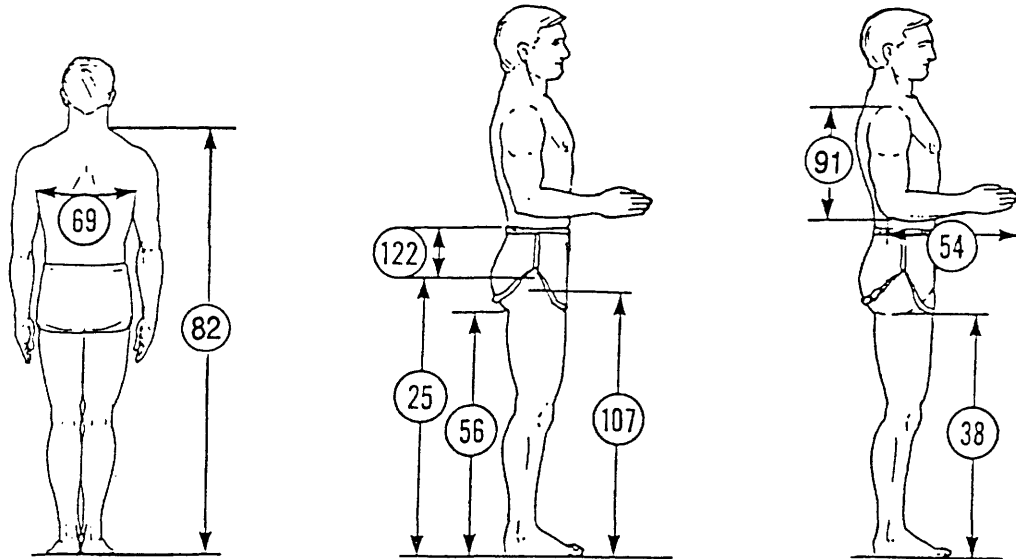
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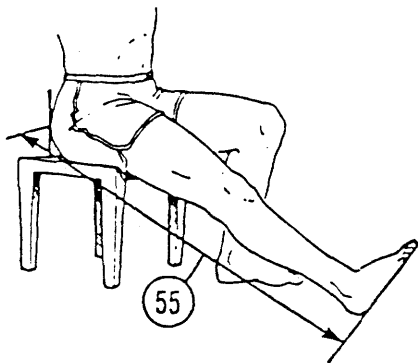
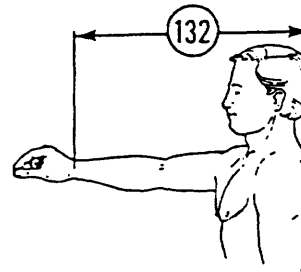
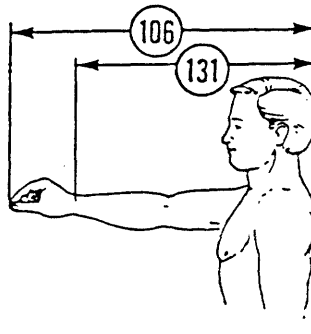
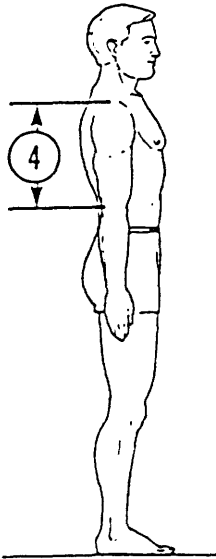
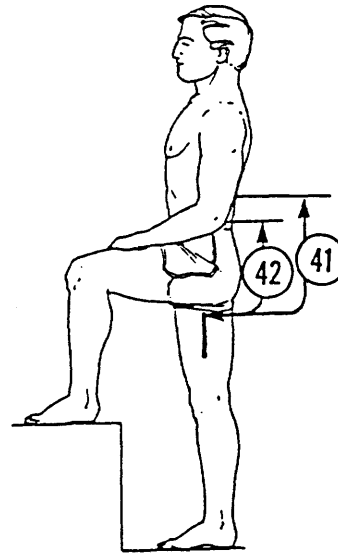
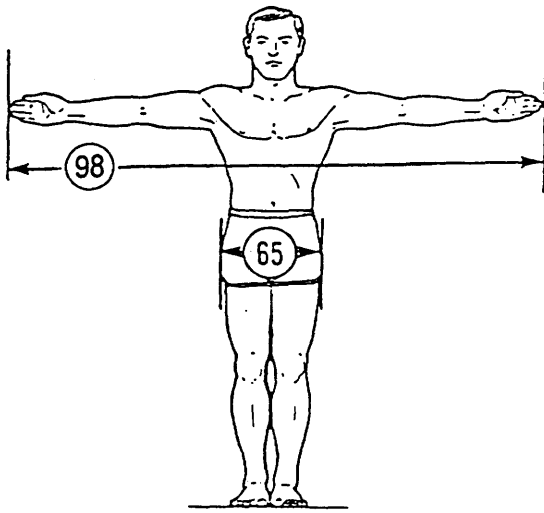
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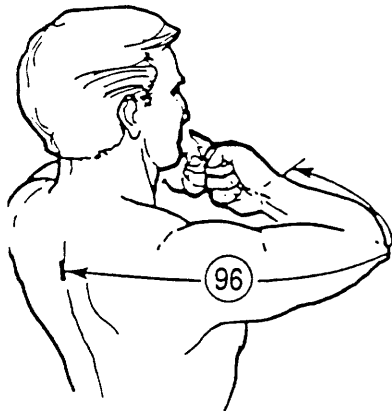
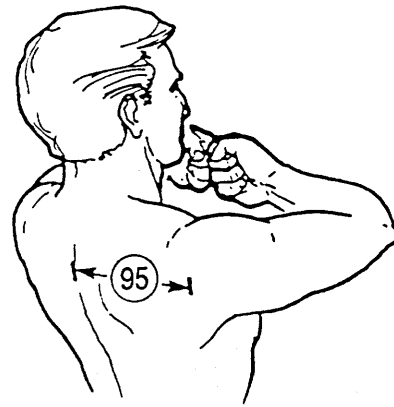
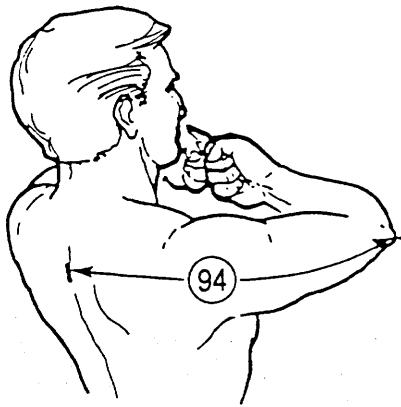
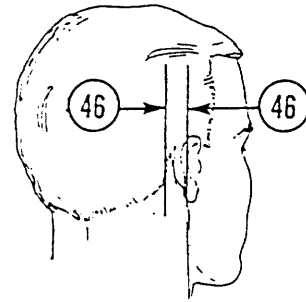
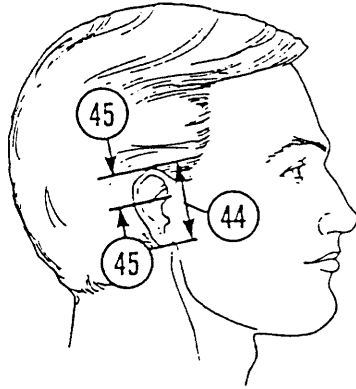
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(45) EAR LENGTH ABOVE TRAGION

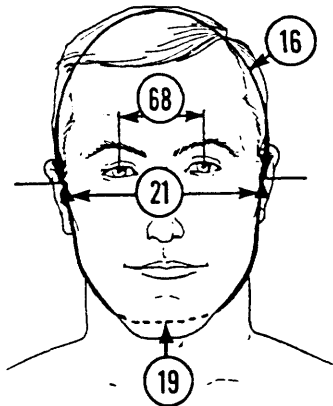
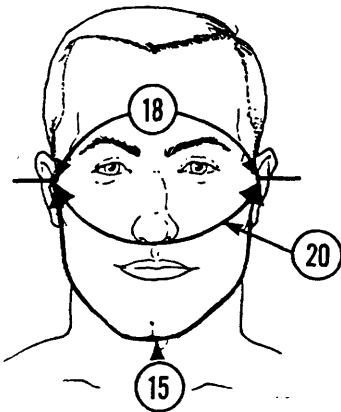
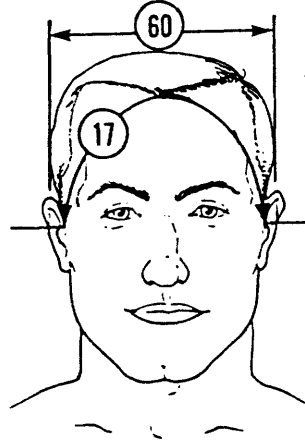
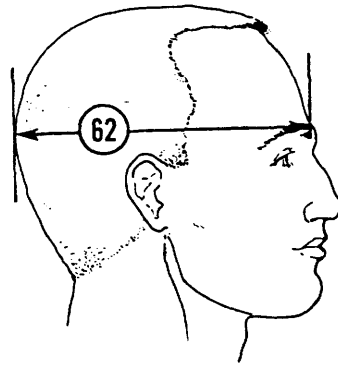
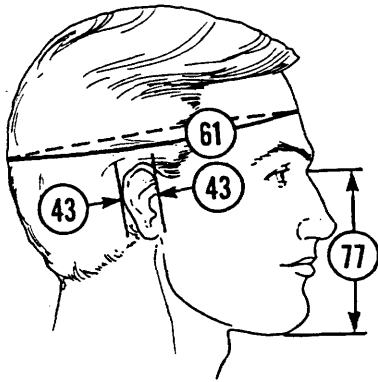
(46) EAR PROTRUSION

(94) SLEEVE LENGTH: SPINE-ELBOW

(95) SLEEVE LENGTH: SPINE-SCYE

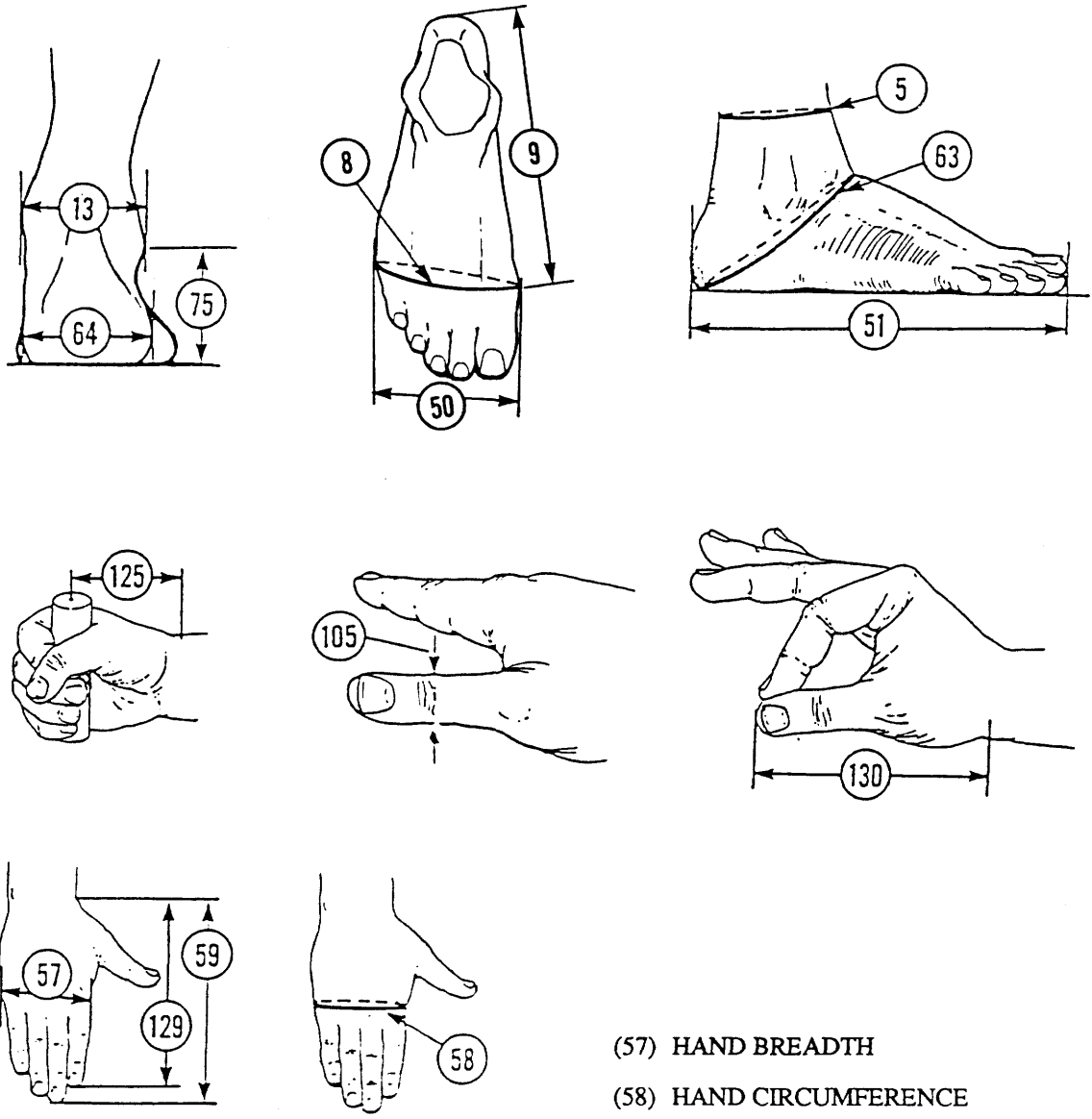
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- (58) HAND CIRCUMFERENCE
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- (63) HEEL ANKLE CIRCUMFERENCE
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- (75) LATERAL MALLEOLUS HEIGHT
- (105) THUMB BREADTH
- (125) WRIST-CENTER OF GRIP LENGTH
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STANDARD MEASUREMENT DESCRIPTIONS

(1) **ABDOMINAL EXTENSION DEPTH, SITTING**

The horizontal distance between the anterior point of the abdomen and the back at the same level is measured with a beam caliper. The subject sits erect looking straight ahead. The measurement is made at the maximum point of quiet respiration.

(2) **ACROMIAL HEIGHT**

The vertical distance between a standing surface and the acromion landmark on the tip of the right shoulder is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is made at the maximum point of quiet respiration.

(3) **ACROMIAL HEIGHT, SITTING**

The vertical distance between a sitting surface and the acromion landmark on the tip of the right shoulder is measured with an anthropometer. The subject sits erect looking straight ahead. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The measurement is made at the maximum point of quiet respiration.

(4) **ACROMION-RADIALE LENGTH**

The distance between the acromion landmark on the tip of the right shoulder and the radiale landmark on the right elbow is measured with a beam caliper held parallel to the long axis of the arm. The subject stands erect. The shoulders and upper extremities are relaxed with the palms facing the thighs.

(5) **ANKLE CIRCUMFERENCE**

The minimum horizontal circumference of the right ankle is measured with a tape. The subject stands with the feet about 10 cm apart and the weight distributed equally on both feet.

(6) **AXILLA HEIGHT**

The vertical distance between a standing surface and the right axillary fold, as designated by the anterior-scye-on-the-torso landmark, is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together with the weight

distributed equally on both feet. The shoulders and upper extremities are relaxed with the palms facing the thighs. The measurement is taken at the maximum point of quiet respiration.

(7) **AXILLARY ARM CIRCUMFERENCE**

The circumference of the right upper arm perpendicular to its long axis at the level of the anterior-scye-on-the-upper-arm landmark is measured with a tape. The subject stands erect looking straight ahead with shoulders and upper extremities relaxed and the palms facing the sides.

(8) **BALL OF FOOT CIRCUMFERENCE**

The circumference of the foot at the first and fifth metatarsophalangeal landmarks on the ball of the right foot is measured with a tape. The subject stands with the feet about 10 cm apart and the weight distributed equally on both feet.

(9) **BALL OF FOOT LENGTH**

The distance from the back of the heel to the landmark at the first metatarsophalangeal protrusion on the ball of the right foot is measured in a footbox. The subject stands erect with each foot in a footbox. The weight is distributed equally on both feet. The medial side of the right foot is parallel with the long axis of the box.

(10) **BIACROMIAL BREADTH**

The distance between the right and left acromion landmarks at the tips of the shoulders is measured with a beam caliper. The subject sits erect. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The measurement is taken at the maximum point of quiet respiration.

(11) **BICEPS CIRCUMFERENCE, FLEXED**

The circumference of the right upper arm around the flexed biceps muscle is measured with a tape held perpendicular to the long axis of the upper arm. The subject stands with the upper arm extended horizontally and the elbow flexed 90 degrees. The fist is clenched and held facing the head, and the subject exerts maximum effort in "making a muscle."

(12) **BIDELTOID BREADTH**

The maximum horizontal distance between the lateral margins of the upper arms on the deltoid muscles is measured with a beam caliper. The subject sits erect looking straight ahead. The shoulders and upper arms are relaxed and the forearms and hands are

extended forward horizontally with the palms facing each other. The measurement is made at the maximum point of quiet respiration.

(13) **BIMALLEOLAR BREADTH**

The horizontal distance between the maximum protrusions of the ankle bones (lateral and medial malleoli) of the right foot is measured with a Holtain caliper. The subject stands with the weight equally distributed on both feet.

(14) **BISPINOUS BREADTH**

The straight-line distance between the right and left anterior superior iliac spine landmarks is measured with a beam caliper. The subject stands looking straight ahead with the heels together and the weight distributed equally on both feet. **Note:** The possibility of slight variations in measuring techniques between male and female measurers should be noted when combining male and female data for this dimension. (See Chapter VII.)

(15) **BITRAGION CHIN ARC**

The surface distance between the right and left trasion landmarks across the chin landmark at the tip of the chin is measured with a tape. The teeth are lightly occluded.

(16) **BITRAGION CORONAL ARC**

The surface distance between the right and left trasion landmarks across the top of the head is measured with a tape. The head is in the Frankfort plane.

(17) **BITRAGION CRINION ARC**

The surface distance between the right and left trasion landmarks across the top of the forehead at the lowest point of the hairline (crinion) is measured with a tape.

(18) **BITRAGION FRONTAL ARC**

The surface distance between the right and left trasion landmarks across the forehead just above the ridges of the eyebrow is measured with a tape.

(19) **BITRAGION SUBMANDIBULAR ARC**

The surface distance between the right and left trasion landmarks across the submandibular landmark at the juncture of the jaw and the neck is measured with a tape. The head is in the Frankfort plane and the teeth are lightly occluded.

(20) BITRAGION SUBNASALE ARC

The surface distance between the right and left tracion landmarks across the subnasale landmark just under the nose is measured with a tape.

(21) BIZYGOMATIC BREADTH

The maximum horizontal breadth of the face (between the zygomatic arches) is measured with a spreading caliper.

(22) BUSTPOINT/THELION-BUSTPOINT/THELION BREADTH

The distance between the right and left bustpoint landmarks on women and the center of the nipples (thelion) on men is measured with a beam caliper. The subject stands erect looking straight ahead. The shoulders and upper extremities are relaxed. The measurement is made at the maximum point of quiet respiration.

(23) BUTTOCK CIRCUMFERENCE

The horizontal circumference of the trunk at the level of the maximum protrusion of the right buttock is measured with a tape. The subject stands erect with the heels together and the weight equally distributed on both feet.

(24) BUTTOCK DEPTH

The horizontal depth of the torso at the level of the maximum protrusion of the right buttock is measured using a beam caliper with a fixed paddle blade. The subject stands erect with the heels together and the weight distributed equally on both feet.

(25) BUTTOCK HEIGHT

The vertical distance between a standing surface and the level of the maximum protrusion of the right buttock is measured with an anthropometer at the right side of the thigh. The subject stands erect with the heels together and the weight distributed equally on both feet.

(26) BUTTOCK-KNEE LENGTH

The horizontal distance between a buttock plate placed at the most posterior point on either buttock and the anterior point of the right knee is measured with an anthropometer. The subject sits erect. The thighs are parallel and the knees flexed 90 degrees with the feet in line with the thighs.

(27) BUTTOCK-POPLITEAL LENGTH

The horizontal distance between a buttock plate placed at the most posterior point on either buttock and the back of the right knee (the popliteal fossa at the dorsal juncture of the calf and thigh) is measured with an anthropometer. The subject sits erect. The thighs are parallel and the knees flexed 90 degrees with the feet in line with the thighs.

(28) CALF CIRCUMFERENCE

The *maximum horizontal circumference* of the right calf is measured with a tape. The subject stands erect with the heels approximately 10 cm apart and the weight distributed equally on both feet.

(29) CALF HEIGHT

The vertical distance between a standing surface and the level of the *maximum circumference of the right calf* is measured with an anthropometer. The subject stands erect with the heels together and the weight distributed equally on both feet.

(30) CERVICALE HEIGHT

The vertical distance between a standing surface and the cervicale landmark on the spine at the base of the neck is measured with an anthropometer. The subject stands erect with the head in the Frankfort plane. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(31) CERVICALE HEIGHT, SITTING

The vertical distance between a sitting surface and the cervicale landmark on the spine at the base of the neck is measured with an anthropometer. The subject sits erect looking straight ahead. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The thighs are parallel and the knees are flexed 90 degrees. The measurement is taken at the maximum point of quiet respiration.

(32) CHEST BREADTH

The maximum horizontal breadth of the chest at the level of the right bustpoint on women or the nipple on men is measured with a beam caliper. The subject stands erect looking straight ahead with the heels together, the weight distributed equally on both feet. The measurement is taken at the maximum point of quiet respiration. **Note:** Breast tissue and latissimus dorsi muscle tissue are NOT included in this measurement if they extend beyond the rib cage.

(33) CHEST CIRCUMFERENCE

The maximum horizontal circumference of the chest at the fullest part of the breast is measured with a tape. The subject stands erect looking straight ahead. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(34) CHEST CIRCUMFERENCE AT SCYE

The horizontal circumference of the chest at the level of the scye-at-midspine landmark is measured with a tape. The subject stands erect looking straight ahead. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(35) CHEST CIRCUMFERENCE BELOW BREAST

The horizontal circumference of the chest at the level of the inferior juncture of the lowest breast with the rib cage is measured with a tape. On women, the tape may lie on the bra. The subject stands erect looking straight ahead. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(36) CHEST DEPTH

The horizontal distance between the chest, at the level of the right bustpoint on women or the nipple on men, and the back at the same level is measured with a beam caliper. The subject stands erect looking straight ahead. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(37) CHEST HEIGHT

The vertical distance between a standing surface and the right bustpoint on women or the nipple on men is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(38) CROTCH HEIGHT

The vertical distance between the standing surface and the crotch is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together and the weight is distributed equally on both feet.

(39) CROTCH LENGTH (NATURAL INDENTATION)

The distance between the abdomen at the level of the natural indentation of the waist to the same level on the back is measured with a tape passing through the crotch to the right of the genitalia. The tape is held vertically both in front and in back. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The measurement is taken at the maximum point of quiet respiration.

(40) CROTCH LENGTH (OMPHALION)

The distance between the abdomen at the level of the center of the navel (omphalion) to the same level on the back is measured with a tape passing through the crotch to the right of the genitalia. The tape is held vertically both in front and in back. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The measurement is taken at the maximum point of quiet respiration.

(41) CROTCH LENGTH, POSTERIOR (NATURAL INDENTATION)

The surface distance from the crotch at the inner thigh landmark to the back of the waist at the posterior natural-indentation landmark is measured with a tape. The tape passes between the buttocks to the back of the waist. The subject stands with the left foot on a platform so that the knee is flexed.

(42) CROTCH LENGTH, POSTERIOR (OMPHALION)

The surface distance from the crotch at the inner thigh landmark to the back of the waist at the level of the center of the navel (omphalion) is measured with a tape. The tape passes between the buttocks to the back of the waist. The subject stands with the left foot on a platform so that the knee is flexed.

(43) EAR BREADTH

The maximum breadth of the right ear perpendicular to its long axis is measured with a sliding caliper.

(44) EAR LENGTH

The length of the right ear from its highest to lowest points on a line parallel to the long axis of the ear is measured with a sliding caliper.

(45) EAR LENGTH ABOVE TRAGION

The distance from the right tragion landmark to the top of the right ear on a line parallel to the long axis of the ear is measured with a sliding caliper.

(46) EAR PROTRUSION

The horizontal distance between the mastoid process (the bony area behind the bottom of the ear) and the outside edge of the right ear at its most lateral point is measured using a sliding caliper with its slide reversed.

(47) ELBOW CIRCUMFERENCE

The circumference of the right elbow in a plane perpendicular to the long axis of the arm is measured with a tape passing around the elbow at the level of the olecranon-center landmark. The subject stands with the arm straight and slightly away from the side.

(48) ELBOW REST HEIGHT

The vertical distance between a sitting surface and the olecranon landmark on the bottom of the flexed right elbow is measured with an anthropometer. The subject sits erect looking straight ahead. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The measurement is taken at the maximum point of quiet respiration.

(49) EYE HEIGHT, SITTING

The vertical distance between a sitting surface and the ectocanthus landmark on the outer corner of the right eye is measured with an anthropometer. The subject sits erect with the head in the Frankfort plane. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The thighs are parallel and the knees are flexed 90 degrees with the feet in line with the thighs. The measurement is taken at the maximum point of quiet respiration.

(50) FOOT BREADTH, HORIZONTAL

The maximum breadth of the right foot is measured on a footbox scale. The subject stands with each foot in a footbox and the weight distributed equally on both feet. The heel of the right foot lightly touches the back of the box, and the side of the foot at the fifth-metatarsophalangeal-protrusion landmark lightly touches the side of the box. The medial side of the foot is parallel to the long axis of the box. A block is placed against the landmark at the first metatarsophalangeal protrusion to establish the measurement on the scale.

(51) FOOT LENGTH

The maximum length of the right foot is measured on a footbox scale. The subject stands with each foot in a footbox and the weight distributed equally on both feet. The heel of the right foot lightly touches the back of the box, and the side of the foot at the fifth-metatarsophalangeal-protrusion landmark lightly touches the side of the box. The medial side of the foot is parallel to the long axis of the box. A block is placed against the tip of the longest toe to establish the measurement on the scale.

(52) FOREARM CIRCUMFERENCE, FLEXED

The circumference of the flexed right forearm is measured with a tape passing across the crease at the juncture between the upper arm and the forearm. The measurement is made in a plane perpendicular to the long axis of the forearm. The subject stands with the upper arm extended forward horizontally, the elbow flexed 90 degrees, and the fist tightly clenched and held facing the head.

(53) FOREARM-FOREARM BREADTH

The maximum horizontal distance across the upper body between the outer sides of the forearms is measured with a beam caliper. The subject sits erect looking straight ahead. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The measurement is taken at the maximum point of quiet respiration.

(54) FOREARM-HAND LENGTH

The horizontal distance between the back of the tip of the right elbow to the tip of the right middle finger is measured with a beam caliper. The subject stands erect with the upper arms hanging at the sides and the right elbow flexed 90 degrees. The hand is held out straight with the palm facing inward.

(55) FUNCTIONAL LEG LENGTH

The straight-line distance between the plane of the bottom of the right foot with the leg extended and the back of the body of a seated subject is measured with an anthropometer passing over the trochanter landmark on the side of the hip. The subject sits erect on a stool 40.8 cm high. The right leg is extended and the foot is on the base plate of the anthropometer, which rests on the floor. The measurement is made from the footrest surface of the base plate.

(56) GLUTEAL FURROW HEIGHT

The vertical distance between a standing surface and the lowest point of the gluteal furrow(s) under the right buttock is measured with an anthropometer. The subject stands erect with the heels together and the weight distributed equally on both feet.

(57) HAND BREADTH

The breadth of the right hand between the landmarks at metacarpale II and metacarpale V is measured with a sliding caliper. The subject places the palm on a table, the fingers together and the thumb abducted. The middle finger is parallel to the long axis of the forearm. The two distal phalanges of the fingers lie on a flat surface 8 mm higher than the table.

(58) HAND CIRCUMFERENCE

The circumference of the right hand is measured with a tape passing over the landmarks at metacarpale II and metacarpale V. The subject places the palm on a table, the fingers together, and the thumb abducted. The middle finger is parallel to the long axis of the forearm. The two distal phalanges of the fingers lie on a flat surface 8 mm higher than the table.

(59) HAND LENGTH

The length of the right hand between the stylium landmark on the wrist and the tip of the middle finger is measured with a Poech sliding caliper. The subject places the palm on a table, the fingers together, and the thumb abducted. The middle finger is parallel to the long axis of the forearm. The two distal phalanges of the fingers lie on a flat surface 8 mm higher than the table.

(60) HEAD BREADTH

The maximum horizontal breadth of the head above the attachment of the ears is measured with a spreading caliper.

(61) HEAD CIRCUMFERENCE

The maximum circumference of the head above the attachment of the ears to the head is measured with a tape passing just above the ridges of the eyebrows and around the back of the head.

(62) HEAD LENGTH

The distance from the glabella landmark between the browridges to the posterior point on the back of the head is measured with a spreading caliper.

(63) HEEL ANKLE CIRCUMFERENCE

The circumference of the right foot at the ankle and base of the heel is measured with a tape passing over the point at which the heel first contacts the table and over the dorsal-juncture-of-the-foot-and-leg landmark at the front of the ankle. The subject stands with the feet about 10 cm apart and the weight distributed equally on both feet.

(64) HEEL BREADTH

The maximum horizontal distance between the medial and lateral points on the inside and outside of the right heel, at or posterior to the lateral malleolus landmark, is measured with a Holtain caliper. The measurement is taken just above the level of the standing surface at the most protruding points of the curvature of the heel. The subject stands with the feet about 10 cm apart and the weight distributed equally on both feet.

(65) HIP BREADTH

The horizontal distance between the lateral buttock landmarks on the sides of the hips is measured with a beam caliper. The subject stands erect with the heels together and the weight distributed equally on both feet.

(66) HIP BREADTH, SITTING

The distance between the lateral points of the hips or thighs (whichever are broader) is measured with a beam caliper. The subject sits erect with the feet and knees together.

(67) ILIOCRISTALE HEIGHT

The vertical distance between a standing surface and the iliocristale landmark on the top of the right side of the pelvis is measured with an anthropometer. The subject stands erect with the heels together and the weight distributed equally on both feet. The shoulders and upper extremities are relaxed.

(68) INTERPUPILLARY BREADTH

The distance between the two pupils is measured with a pupillometer.

(69) INTERSCYE I

The distance across the back between the right and left posterior-axillary-fold landmarks is measured with a tape. The tape is held on the skin surface except where the tape spans the hollow of the back. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(70) INTERSCYE II

The distance across the back between the right and left midsyce landmarks is measured with a tape. The tape is held on the skin surface except where it spans the hollow of the back. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(71) KNEE CIRCUMFERENCE

The horizontal circumference of the right knee at the level of the midpatella landmark at the center of the knee is measured with a tape. The subject stands erect with the feet about 10 cm apart and the weight distributed equally on both feet.

(72) KNEE HEIGHT, MIDPATELLA

The vertical distance between a standing surface and the midpatella landmark at the center of the right knee is measured with an anthropometer. The subject stands erect with the heels together and the weight distributed equally on both feet.

(73) KNEE HEIGHT, SITTING

The vertical distance between a footrest surface and the suprapatella landmark at the top of the right knee (located and drawn while the subject stands) is measured with an anthropometer. The subject sits with the thighs parallel, the knees flexed 90 degrees, and the feet in line with the thighs.

(74) LATERAL FEMORAL EPICONDYLE HEIGHT

The vertical distance between a standing surface and the standing lateral-femoral-epicondyle landmark on the outside of the right knee is measured with an anthropometer. The subject stands erect with the heels together and the weight distributed equally on both feet.

(75) LATERAL MALLEOLUS HEIGHT

The vertical distance between a standing surface and the lateral malleolus landmark on the outside of the right ankle is measured with a modified sliding caliper. The subject stands erect with the heels together and the weight distributed equally on both feet.

(76) LOWER THIGH CIRCUMFERENCE

The horizontal circumference of the right thigh at the level of the suprapatella landmark at the top of the knee is measured with a tape. The subject stands erect with the feet about 10 cm apart and the weight distributed equally on both feet.

(77) MENTON-SELLION LENGTH

The distance between the menton landmark at the bottom of the chin and the sellion landmark at the deepest point of the nasal root depression is measured with a sliding caliper. The teeth are lightly occluded.

(78) MIDSHOULDER HEIGHT, SITTING

The vertical distance between a sitting surface and the midshoulder landmark at the top of the right shoulder is measured with an anthropometer. The subject sits erect looking straight ahead. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The measurement is taken at the maximum point of quiet respiration.

(79) NECK-BUSTPOINT/THELION LENGTH

The distance between the trapezius landmark at the right side of the neck and the right bustpoint landmark on women or the right nipple (thelion) on men is measured with a tape. The subject stands erect looking straight ahead. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(80) NECK CIRCUMFERENCE

The circumference of the neck at the level of the infrathyroid landmark (Adam's apple) is measured with a tape. The plane of the measurement is perpendicular to the long axis of the neck. The subject stands erect with the head in the Frankfort plane. The shoulders and upper extremities are relaxed.

(81) NECK CIRCUMFERENCE, BASE

The circumference of the base of the neck is measured by a tape passing over the drawn lateral and anterior neck landmarks. The subject stands erect with the head in the Frankfort plane. The shoulders and upper extremities are relaxed.

(82) NECK HEIGHT, LATERAL

The vertical distance between a standing surface and the trapezius landmark on the right side of the neck is measured with an anthropometer. The subject stands erect with the head in the Frankfort plane. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(83) OVERHEAD FINGERTIP REACH

The vertical distance between a standing surface and the tip of the right middle finger when the arm is extended overhead is measured on a wall scale. The subject stands facing a wall-mounted scale with both arms extended overhead parallel to each other. The toes are 20 cm from the wall and the feet are about 10 cm apart. The palms of the hands rest on the scale. A block is placed against the tip of the finger to establish the measurement. The measurement is taken at the maximum point of quiet respiration.

(84) OVERHEAD FINGERTIP REACH, EXTENDED

The vertical distance between a standing surface and the tip of the right middle finger when the arm is extended overhead as high as possible is measured on a wall scale. The subject stands on his/her toes facing a wall-mounted scale with both arms parallel and extended overhead as high as possible. The toes are 20 cm from the wall and the feet are about 10 cm apart. The palms of the hands rest on the scale. A block is placed against the tip of the finger to establish the measurement. The measurement is taken at the maximum point of quiet respiration.

(85) OVERHEAD FINGERTIP REACH, SITTING

The vertical distance between a sitting surface and the tip of the right middle finger of a seated subject whose arm is extended overhead is measured on a wall scale. The subject sits erect on a flat surface 40.8 cm high with the right arm and hand extended vertically overhead as far as possible and the palm of the hand facing forward. Neither the back nor the arm touches a wall. A block placed at the tip of the middle finger spans the distance between the finger and the wall and establishes the measurement on the wall scale. The measurement is made at the maximum point of quiet respiration.

(86) **POPLITEAL HEIGHT**

The vertical distance from a footrest surface to the back of the right knee (the popliteal fossa at the dorsal juncture of the right calf and thigh) is measured with an anthropometer. The subject sits with the thighs parallel, the feet in line with the thighs, and the knees flexed 90 degrees.

(87) **RADIALE-STYLION LENGTH**

The distance between the radiale landmark on the right elbow and the stylium landmark on the right wrist is measured with a beam caliper held parallel to the long axis of the forearm. The subject stands with the arms relaxed at the sides. The hand and fingers are held straight in line with the long axis of the forearm.

(88) **SCYE CIRCUMFERENCE**

The vertical circumference of the right upper arm (scye) is measured with a tape passing through the armpit and over the acromion landmark on the tip of the shoulder. The subject stands erect looking straight ahead. The shoulders and upper extremities are relaxed with the palms facing the thighs.

(89) **SCYE DEPTH**

The surface distance along the spine between the cervicale landmark on the base of the back of the neck and the scye-level-at-midspine landmark is measured with a tape. The subject stands erect with the head in the Frankfort plane. The shoulders and upper extremities are relaxed.

(90) **SHOULDER CIRCUMFERENCE**

The horizontal circumference of the shoulders at the level of the maximum protrusion of the right deltoid muscle is measured with a tape. The subject stands erect looking straight ahead. The shoulders and upper extremities are relaxed with the palms facing the thighs. The measurement is taken at the maximum point of quiet respiration.

(91) **SHOULDER-ELBOW LENGTH**

The distance between the acromion landmark on the tip of the right shoulder and the olecranon landmark on the bottom of the right elbow is measured with a beam caliper parallel to the long axis of the upper arm. The subject stands with the right upper arm hanging at the side and the elbow flexed 90 degrees. The hand is straight, and the palm faces inward.

(92) SHOULDER LENGTH

The surface distance between the trapezius landmark at the base of the side of the neck and the acromion landmark on the tip of the right shoulder is measured with a tape. The subject stands looking straight ahead. The shoulders and upper extremities are relaxed.

(93) SITTING HEIGHT

The vertical distance between a sitting surface and the top of the head is measured with an anthropometer. The subject sits erect with the head in the Frankfort plane. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The thighs are parallel and the knees are flexed 90 degrees with the feet in line with the thighs. The measurement is made at the maximum point of quiet respiration.

(94) SLEEVE LENGTH: SPINE-ELBOW

The horizontal surface distance between the midspine landmark and the olecranon-center landmark on the tip of the raised elbow is measured with a tape. The measurement is made while the subject holds his/her arms up in a horizontal position parallel to the standing surface and joins them by bringing the fists together at the metacarpophalangeal and proximal interphalangeal knuckles. The forearms and fists are in a straight line.

(95) SLEEVE LENGTH: SPINE-SCYE

The horizontal surface distance between the midspine landmark and the right posterior-diagonal-scye landmark at the back of the raised right arm near the armpit is measured with a tape. The measurement is made while the subject holds his/her arms up in a horizontal position parallel to the standing surface and joins them by bringing the fists together at the metacarpophalangeal and proximal interphalangeal knuckles. The forearms and fists are in a straight line.

(96) SLEEVE LENGTH: SPINE-WRIST

The horizontal surface distance from the midspine landmark, across the olecranon-center landmark at the tip of the raised right elbow, to the dorsal wrist landmark is measured with a tape. The measurement is made while the subject holds his/her arms up in a horizontal position parallel to the standing surface and joins them by bringing the fists together at the metacarpophalangeal and proximal interphalangeal knuckles. The forearms and fists are in a straight line.

(97) SLEEVE OUTSEAM

The straight-line distance between the acromion landmark on the tip of the right shoulder and the stylium landmark on the right wrist is measured with a tape. The subject stands erect with both arms straight at the sides and the palms facing forward.

(98) SPAN

The distance between the tips of the middle fingers of the horizontally outstretched arms is measured on a wall chart. The subject stands erect with the back against a wall-mounted scale and the heels together. Both arms and hands are stretched horizontally against a back wall with the tip of the middle finger of one hand just touching a side wall. A block is placed at the tip of the middle finger of the other hand to establish the measurement on the scale. The measurement is taken at the maximum point of quiet respiration.

(99) STATURE

The vertical distance from a standing surface to the top of the head is measured with an anthropometer. The subject stands erect with the head in the Frankfort plane. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(100) STRAP LENGTH

The surface distance from the right bustpoint landmark on women or the right nipple (thelion) on men across the back of the neck to the left bustpoint or nipple is measured with a tape passing over the left and right lateral neck landmarks. The subject stands erect with the head in the Frankfort plane. The shoulders and upper extremities are relaxed. The measurement is made at the maximum point of quiet respiration.

(101) SUPRASTERNALE HEIGHT

The vertical distance between a standing surface and the suprasternale landmark on the notch at the top of the breastbone is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is made at the maximum point of quiet respiration.

(102) TENTH RIB HEIGHT

The vertical distance between a standing surface and the tenth rib landmark at the bottom of the right side of the rib cage is measured with an anthropometer. The subjects stands

erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is made at the maximum point of quiet respiration.

(103) THIGH CIRCUMFERENCE

The circumference of the right thigh at its juncture with the buttock is measured with a tape. The measurement is made perpendicular to the long axis of the thigh. The subject stands erect with the weight distributed equally on both feet. The legs are spread apart just enough so that the thighs do not touch.

(104) THIGH CLEARANCE

The vertical distance between a sitting surface and the highest point on the top of the right thigh is measured with an anthropometer. The subject sits with the thighs parallel, knees flexed 90 degrees, and the feet in line with the thighs.

(105) THUMB BREADTH

The maximum breadth of the right thumb perpendicular to its long axis is measured with a Holtain caliper. The thumb is straight and held away from the hand at about a 45-degree angle.

(106) THUMB TIP REACH

The horizontal distance from a back wall to the tip of the right thumb is measured on a wall scale. The subject stands erect in a corner looking straight ahead with the feet together and the heels 20 cm from the back wall. The buttocks and shoulders are against the wall. The right arm and hand, palm down, are stretched forward horizontally along a scale on the side wall. The thumb continues the horizontal line of the arm and the index finger curves around to touch the pad at the end of the thumb. The subject's right shoulder is held against the rear wall.

(107) TROCHANTERIC HEIGHT

The vertical distance between a standing surface and the trochanterion landmark on the upper side of the right thigh is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet.

(108) VERTICAL TRUNK CIRCUMFERENCE (ASCC)*

The vertical circumference of the torso is measured with a tape passing between the buttocks, to the right of the genitalia, over the right bustpoint landmark on women or the nipple (thelion) on men, and across the midshoulder landmark. The subject stands erect looking straight ahead with the right arm hanging relaxed at the side. The heels are together with the weight distributed equally on both feet. The measurement is taken at the midpoint of quiet respiration.

* Aircrew Standardization Coordinating Committee

(109) VERTICAL TRUNK CIRCUMFERENCE (USA)*

The vertical circumference of the torso is measured with a tape passing over the maximum protrusion of the right buttock, to the right of the genitalia, over the right bustpoint landmark on women or the nipple (thelion) on men, and across the midshoulder landmark. The subject stands erect looking straight ahead with the right arm hanging relaxed at the side. The heels are together with the weight distributed equally on both feet. The measurement is taken at the maximum point of quiet respiration.

*U.S. Army

(110) WAIST BACK LENGTH (NATURAL INDENTATION)

The surface distance between the cervicale landmark on the back of the neck and the posterior-waist (natural indentation) landmark is measured with a tape. The subject stands erect with the head in the Frankfort plane. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(111) WAIST BACK LENGTH (OMPHALION)

The surface distance between the cervicale landmark at the back of the neck and the posterior-waist (omphalion) landmark at the level of the navel is measured with a tape. The subject stands erect with the head in the Frankfort plane. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

(112) WAIST BREADTH

The horizontal breadth of the waist at the level of omphalion is measured with a beam caliper. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The measurement is taken at the maximum point of quiet respiration.

(113) WAIST CIRCUMFERENCE (NATURAL INDENTATION)

The horizontal circumference of the waist at the level of its natural indentation is measured with a tape passing over right and left waist (natural indentation) landmarks. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The measurement is made at the maximum point of quiet respiration.

(114) WAIST CIRCUMFERENCE (OMPHALION)

The horizontal circumference of the waist at the level of the center of the navel (omphalion) is measured with a tape. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The measurement is made at the maximum point of quiet respiration.

(115) WAIST DEPTH

The horizontal distance between the front and back of the waist at the level of the center of the navel (omphalion) is measured with a beam caliper. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The measurement is taken at the maximum point of quiet respiration.

(116) WAIST FRONT LENGTH (NATURAL INDENTATION)

The surface distance between the anterior-neck landmark and the anterior-waist (natural indentation) landmark is measured with a tape. The subject stands erect with the head in the Frankfort plane. The measurement is made at the maximum point of quiet respiration.

(117) WAIST FRONT LENGTH (OMPHALION)

The surface distance between the anterior-neck landmark and the center of the navel (omphalion) is measured with a tape. The subject stands erect with the head in the Frankfort plane. The measurement is made at the maximum point of quiet respiration.

(118) WAIST HEIGHT (NATURAL INDENTATION)

The vertical distance between a standing surface and the landmark at the natural indentation of the right waist is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is made at the maximum point of quiet respiration.

(119) WAIST HEIGHT (OMPHALION)

The vertical distance between a standing surface and the center of the navel (omphalion) is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is made at the maximum point of quiet respiration.

(120) WAIST HEIGHT, SITTING (NATURAL INDENTATION)

The vertical distance from a sitting surface to the landmark at the natural indentation of the right waist is measured with an anthropometer. The subject sits erect looking straight ahead. The knees are flexed 90 degrees. The measurement is made at the maximum point of quiet respiration.

(121) WAIST HEIGHT, SITTING (OMPHALION)

The vertical distance from a sitting surface to the center of the navel (omphalion) is measured with an anthropometer. The subject sits erect looking straight ahead. The knees are flexed 90 degrees. The measurement is made at the maximum point of quiet respiration.

(122) WAIST-HIP LENGTH

The surface distance between the right waist (omphalion) landmark and the right lateral-buttock-point landmark on the side of the hip is measured with a tape. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet.

(123) WAIST (NATURAL INDENTATION)-WAIST (OMPHALION) LENGTH

The surface distance between the right waist (natural indentation) and right waist (omphalion) landmarks is measured with a tape. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet.

(124) WEIGHT

The weight of the subject is taken to the nearest tenth of a kilogram. The subject stands on the platform of a scale.

(125) WRIST-CENTER OF GRIP LENGTH

The horizontal distance between the stylium landmark on the right wrist and the center of a dowel (1-1/4" diameter) gripped in the right hand is measured with a Poech caliper. The subject sits grasping a dowel in the right hand. The base of the dowel is flush with the bottom of the fist. The subject puts the bottom of the fist on a flat surface in such a way that the base of the dowel rests on the surface. The fist is in line with the long axis of the forearm.

(126) WRIST CIRCUMFERENCE

The circumference of the wrist perpendicular to the long axis of the forearm is measured with a tape passing over the stylium landmark on the wrist. The subject extends the right arm forward with the palm up.

(127) WRIST HEIGHT

The vertical distance between a standing surface and the stylium landmark on the right wrist is measured with an anthropometer. The subject stands erect looking straight ahead with the heels together and the weight distributed equally on both feet. The shoulders are relaxed and the arms are extended downwards with the elbow, wrist, and fingers held rigidly straight. The arms lightly touch the sides. The measurement is taken at the maximum point of quiet respiration.

(128) WRIST HEIGHT, SITTING

The vertical distance between the floor and the stylium landmark on the right wrist of a seated subject is measured with an anthropometer. The subject sits erect with the trochanter landmark on the hip lined up with a marker placed about 7 cm from the front edge of the seat. The subject looks straight ahead. The shoulders are relaxed and the arms are extended downwards with the elbow, wrist, and fingers held rigidly straight. The arms lightly touch the sides. The measurement is taken at the maximum point of quiet respiration with the subject holding his/her breath. **Note:** The height of the seat used in this measurement was 45.5 cm.

(129) WRIST-INDEX FINGER LENGTH

The distance between the stylium landmark on the right wrist and the tip of the right index finger is measured with a Poech caliper. The subject places the palm on a table, the fingers together, and the thumb abducted. The middle finger is parallel to the long axis of the forearm. The two distal phalanges of the fingers lie on a flat surface 8 mm higher than the table.

(130) WRIST-THUMB TIP LENGTH

The horizontal distance between the stylium landmark on the right wrist and the tip of the right thumb is measured with a Poech caliper. The subject rests the little finger side of the hand on a flat surface. The thumb is held straight and in line with the long axis of the forearm. The thumb rests on the first knuckle of the curved index finger.

(131) WRIST-WALL LENGTH

The horizontal distance between a back wall and the stylium landmark on the right wrist of the outstretched arm is measured on a wall scale. The subject stands erect in a corner looking straight ahead with the feet together and the heels 20 cm from the back wall. The buttocks and shoulders are against the wall. The right arm and hand with the palm down are stretched forward horizontally against a scale on the side wall. The thumb continues the horizontal line of the arm and the index finger curves around to touch the pad at the end of the thumb. The subject's right shoulder is held against the rear wall.

(132) WRIST-WALL LENGTH, EXTENDED

The horizontal distance between a back wall and the stylium landmark on the right wrist of the maximally outstretched arm is measured on a wall scale. The subject stands erect in a corner looking straight ahead with the feet together and the heels 20 cm from the back wall. The buttocks and left shoulder are against the wall. The right arm and hand with the palm down are stretched forward horizontally as far as possible against the side wall. The thumb continues the horizontal line of the arm and the index finger curves around to touch the pad at the end of the thumb. The subject's left shoulder is held against the rear wall.