

CHAPTER III ANTHROPOMETRY

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Anthropometry, the practice of measuring the parts and proportions of the human body, encompasses a variety of techniques for determining an almost limitless number of dimensions. Each user of anthropometric data has his own list of dimensions that he considers essential for his purposes. Unfortunately, the list of one user seldom coincides with the list preferred by another. As a consequence, the literature of anthropometry contains many tabulations of data that are unique to a particular investigation, survey or design situation. At the same time, as the number of measured variables grows it becomes increasingly difficult to tabulate them in any usable fashion. In 1942 the young Army Air Force anthropology group included 55 measurements in its anthropometric survey of the body size of aircrewmembers (Randall et al. 1946). In the next major USAF survey, conducted in 1950, the number of measurements had grown to 132 (Hertzberg et al. 1954), and in the most recent such survey, conducted in 1967, the number of variables had reached a total of 190 (Churchill et al. 1977). When the anthropometric data available on worldwide populations is compiled, with each survey contributing a few unique dimensions, the task of collation and presentation becomes formidable.

In Volume II of this book we have collected and tabulated the anthropometric data from every survey available to us, making it probably as comprehensive a reference book as has ever been compiled on the subject. A condensed and summarized version of this material appears in this chapter. Data on 59 variables, selected for their relevance to NASA design problems, are tabulated for 12 U.S. and foreign populations which represent countries involved in the space shuttle program (see Table 1).

Appendix B contains predicted body-size dimensions for the U.S. astronaut population of 1985. Data includes estimated measurements of the same 59 dimensions for average, 5th and 95th percentile men and women based on a projection of data from military surveys conducted in the past several decades.

As a further aid to NASA engineers involved in crew station design, Appendix C describes the most up-to-date two-dimensional drawing board manikins currently available and provides information on how to obtain plans for fabricating the models.* Actual patterns for simplified versions

* USAF 2-D manikins developed by Kenneth W. Kennedy, Aerospace Medical Research Laboratories, Wright Patterson Air Force Base, Ohio.

TABLE 1

A SUMMARY OF THE ANTHROPOMETRIC DATA AVAILABLE FOR TWELVE SAMPLE POPULATIONS

	U.S.A.F. Females 1968	U.S.A. NEW Civ Females 1960-62	British Civ. Females 1957	Swedish Civ. Females 1968	Japanese Civ. Females 68 & 1972-73	U.S.A.F. Pliers 1967- 68 & 1972-73	MASA Astro- nauts Dates Vary	British Pliers 1970-71	Italian Military 1960	French Pliers 1973	German Air Force 1975	Japanese Civ. 1967-68 1972-73
Weight	X	X	X	X	X	X	X	X	X	X	X	X
Stature	X	X	X	X	X	X	X	X	X	X	X	X
Acromial Height (Shoulder Height)	X	X	X	X	X	X	X	X	X	X	X	X
Waist Height	X	X	X	X	X	X	X	X	X	X	X	X
Crotch Height	X	X	X	X	X	X	X	X	X	X	X	X
Trochanteric Height	X	X	X	X	X	X	X	X	X	X	X	X
Tibiale Height	X	X	X	X	X	X	X	X	X	X	X	X
Calf Height	X	X	X	X	X	X	X	X	X	X	X	X
Ankle Height	X	X	X	X	X	X	X	X	X	X	X	X
Radiale Height (Elbow Height)	X	X	X	X	X	X	X	X	X	X	X	X
Styloid Height (Wrist Height)	X	X	X	X	X	X	X	X	X	X	X	X
Sitting Height	X	X	X	X	X	X	X	X	X	X	X	X
Eye Height, Sitting	X	X	X	X	X	X	X	X	X	X	X	X
Midshoulder Height, Sitting	X	X	X	X	X	X	X	X	X	X	X	X
Elbow Rest Height, Sitting	X	X	X	X	X	X	X	X	X	X	X	X
Knee Height, Sitting	X	X	X	X	X	X	X	X	X	X	X	X
Popliteal Height, Sitting	X	X	X	X	X	X	X	X	X	X	X	X
Shoulder-Elbow Length	X	X	X	X	X	X	X	X	X	X	X	X
Forearm-Hand Length	X	X	X	X	X	X	X	X	X	X	X	X
Buttock-Popliteal Length	X	X	X	X	X	X	X	X	X	X	X	X
Buttock-Knee Length	X	X	X	X	X	X	X	X	X	X	X	X
Thumb-Tip Reach	X	X	X	X	X	X	X	X	X	X	X	X
Thigh Clearance Height, Sitting	X	X	X	X	X	X	X	X	X	X	X	X
Biacromial Breadth	X	X	X	X	X	X	X	X	X	X	X	X
Bideltoid Breadth (Shoulder Breadth)	X	X	X	X	X	X	X	X	X	X	X	X
Hip Breadth, Sitting	X	X	X	X	X	X	X	X	X	X	X	X
Chest (Bust) Depth	X	X	X	X	X	X	X	X	X	X	X	X
Chest (Bust) Breadth	X	X	X	X	X	X	X	X	X	X	X	X
Hip Breadth, Standing	X	X	X	X	X	X	X	X	X	X	X	X
Neck Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Shoulder Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Chest (Bust) Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Waist Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Hip Circumference, Maximum	X	X	X	X	X	X	X	X	X	X	X	X
Upper Thigh Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Knee Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Calf Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Arm Circumference at Scye	X	X	X	X	X	X	X	X	X	X	X	X
Biceps Circumference, Flexed	X	X	X	X	X	X	X	X	X	X	X	X
Biceps Circumference, Relaxed	X	X	X	X	X	X	X	X	X	X	X	X
Forearm Circumference, Flexed	X	X	X	X	X	X	X	X	X	X	X	X
Forearm Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Wrist Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Vertical Trunk Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Sleeve Length	X	X	X	X	X	X	X	X	X	X	X	X
Waist Front Length	X	X	X	X	X	X	X	X	X	X	X	X
Waist Back Length	X	X	X	X	X	X	X	X	X	X	X	X
Shoulder Length	X	X	X	X	X	X	X	X	X	X	X	X
Interscye	X	X	X	X	X	X	X	X	X	X	X	X
Head Length	X	X	X	X	X	X	X	X	X	X	X	X
Head Breadth	X	X	X	X	X	X	X	X	X	X	X	X
Head Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Hand Length	X	X	X	X	X	X	X	X	X	X	X	X
Hand Breadth	X	X	X	X	X	X	X	X	X	X	X	X
Hand Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Foot Length	X	X	X	X	X	X	X	X	X	X	X	X
Foot Breadth	X	X	X	X	X	X	X	X	X	X	X	X
Foot Circumference	X	X	X	X	X	X	X	X	X	X	X	X
Face Length	X	X	X	X	X	X	X	X	X	X	X	X
Face Breadth	X	X	X	X	X	X	X	X	X	X	X	X

of these manikins are provided in the Appendix for the designer who does not require the full capabilities of the more complicated USAF 2-D manikin. Detailed instructions are given to enable the user to trace, cut out and assemble serviceable quarter-scale 5th, 50th and 95th percentile manikins.

Measurement Techniques

It is difficult to document the numerous subtle differences in the techniques of measurement, landmark definition or interpretation inherent in data from such a wide variety of sources as is presented here. Although in many instances these differences are of little practical significance, in some cases they may be important to the design engineer. Certainly it is essential that he be aware that such variations exist when he compares anthropometric data from different sources.

Traditionally in the United States, anthropometric studies have employed a set of instruments like those shown in Figure 1. The anthropometer (A and B), the basic tool of the anthropometrist, is used to measure all linear dimensions. The detached upper half (A) forms a beam caliper to measure breadths, depths and segment lengths. The smaller sliding (C) and spreading (D) calipers are used primarily to measure dimensions of the head, face, hands and feet. The steel tape (E) is used for body circumferences.

Despite periodic attempts to develop worldwide standardization of anthropometric procedures (Papillault, 1906; Stewart, 1947; Hertzberg, 1968; Tanner et al. 1969) other instruments and techniques are sometimes used in other countries. During World War II Morant and Gilson (1945) developed an anthropometric procedure in England which is still widely used by British military establishments in body size surveys and by many of the military groups in British Commonwealth countries.

In the most recent anthropometric survey of RAF aircrew (Bolton et al. 1973), a modified Morant rig was used to make the measurements. In order to compare techniques, four measurements were retaken using the instruments and methods normally employed by USAF anthropometrists. The data, analyzed and reported by Turner (1974), indicate that the differences are statistically significant for three of the four measurements (stature, sitting height and bideltoid breadth) and not significant for buttock-knee length. Comparisons are illustrated in Table 2.

Turner concluded, however, that the magnitude of the individual differences between values obtained by the two techniques were on the level of experimental error, that is, equivalent to the variation in results obtained by repeated measurements of the same subject and thus, for all practical purposes, there were no differences between the four measurements studied.

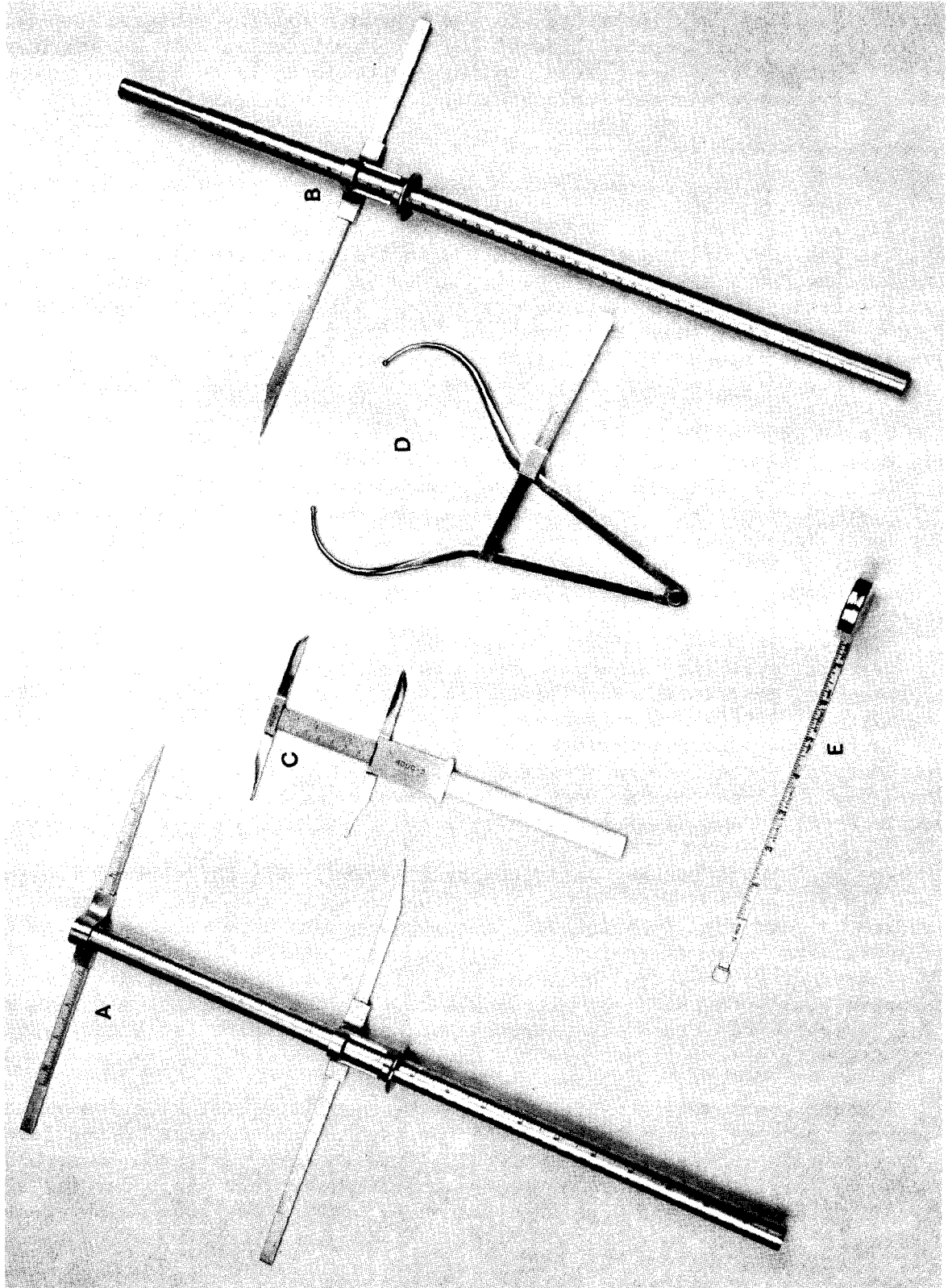


Figure 1. Anthropometric instruments.

TABLE 2
COMPARISON OF UK AND USAF MEASURING TECHNIQUES*

<u>Dimension</u>	<u>UK</u>	<u>USAF</u>	<u>Δ</u>	<u>Significance</u>	<u>$\Delta\%$</u>	<u>r</u>
Stature	1774.4	1770.0	-4.4	p<0.050	0.25	.996
Sitting height	936.0	929.6	-6.4	p<0.001	0.68	.956
Buttock-knee length	607.6	607.3	-0.3	NS	0.05	.930
Bideltoid breadth	465.8	469.8	4.0	p<0.001	0.86	.909

*Mean values in mm.

Not all such comparisons, however, result in such comforting conclusions. Damon (1964) described the differences between two standard methods of measuring adult stature. In one, the subject stands against a wall and is measured with a right-angled device; in the other, he is measured free-standing, with an anthropometer. The differences in technique gave mean results that ranged from 0.2 to 0.8 inches for four groups of men measured under various conditions, with the wall measurement giving the average greater stature.

A number of new methods, aimed at measuring man in three dimensions, are in various stages of development and show much promise for future anthropometric studies. Andrometry is a photographic technique for obtaining three-dimensional coordinates of bodily feature for purposes of accurately determining the size and location of the human operator's anatomy in three-dimensional space (Chaffee 1961). In stereophotogrammetry two or more cameras are used to provide an image from which can be obtained accurate measures of three-dimensional size and shape. While both these methods are well advanced in the experimental stages, no body of anthropometric data has yet resulted. Various other forms of stereometry involving ultrasonics, infra red imagery and laser beams have been conceived for recording precise images for anthropometric uses but as yet these are untried.

While none of the data reported in this book were obtained by any of the three-dimensional techniques described above, much of it was generated by anthropometrists in different times and places using variations of the classic methods. When we found serious discrepancies resulting from differences in technique, we either re-assigned data to another variable which we felt more accurately described the measurement, or deleted the data altogether if we found it incomprehensible. We do not, however, claim that all the remaining data in these volumes are absolutely comparable. The user must make the judgement, within the framework of a particular design problem, about whether differences in instruments, measuring techniques or landmarks will be of practical significance. If small differences will affect his results, it is incumbent upon the user to consult the original survey and make his own assessment or to refer to the excellent two-volume

study, A Collation of Anthropometry by Garrett and Kennedy (1971), in which anthropometric data from some 47 sources have been reviewed and collated to determine the degree of equivalence in measurement techniques.

Variations in positioning subjects is another potential source of artifactual variance in anthropometric measurements. In many studies, subject posture has been standardized to assure that the variation found in body size within a group is truly that associated with body size and not a compounding of this variance by differences in body stance.

For the measurements made on the body standing erect, the subject's body weight is evenly distributed on both feet, heels together as closely as possible, legs and torso straight without stiffness and head erect with the line of vision parallel to the floor. The arms hang straight but loosely at the sides with the palms alongside but not touching the thighs. This posture is similar to the position of military attention but without the stiffness or bracing often associated with it.

To assume the standard posture in sitting erect, the subject sits on a cushionless flat surface, feet on an adjustable footrest so that the knees are flexed to 90 degrees, the long axis of the thighs parallel. The trunk is erect without stiffness and the head is also erect with the path of vision parallel to the plane of the floor. The upper arms are hanging loosely at the sides with elbows flexed at 90 degrees while forearms and hands are held at right angles to the body. Once more, the user is cautioned to consult the original source if comparative data suggests that techniques have not been comparable and if the resulting differences will be significant in the design.

The anthropometric data assembled here and in Volume II are for the nude or lightly clothed body in a standardized posture. Increments for clothing and variations in body posture must be estimated or ascertained. A number of approximations for various clothing and personal protective equipment assemblages have been detailed in Chapter II. Every possible combination of body covering has not, of course, been studied with regard to its effect on body sizing and it rests with the designer either to ascertain what these increments will be for a particular design situation or to select the best available approximation from the incremental data given in Chapter II.

The Data

The 59 dimensions tabulated on the following data pages are believed to be those most relevant to current design problems and the populations selected for inclusion are judged to be those most representative of persons likely to participate in shuttle missions. The complete references to the selected sample populations are listed below:

USAF Women: Clauser, Charles E., Pearl E. Tucker, John T. McConville, E. Churchill, Lloyd L. Laubach, and Joan A. Reardon. 1972. AMRL-TR-70-5, Anthropometry of Air Force Women, Aerospace Medical Research Laboratories, Wright Patterson Air Force Base, Ohio.

U.S. HEW Civ: Stoudt, Howard W., Albert Damon, Ross McFarland, and Jean
(Men & Women) Roberts. 1965. Weight, Height, and Selected Body Dimensions of Adults, Washington, D.C.: National Center for Health Statistics, Series 11, Number 8, U.S. Department of Health, Education and Welfare.

Stoudt, Howard W., Albert Damon, Ross A. McFarland, and Jean Roberts. 1970. Skinfolds, Body Girths, Biacromial Diameter, and Selected Anthropometric Indices of Adults, Washington, D.C.: National Center for Health Statistics, Series 11, Number 35, U.S. Department of Health, Education and Welfare.

British Civ: Kemsley, W. F. F. 1957. Women's Measurements and Sizes. Chel-
(Women) tenham Press Ltd., Cheltenham, England.

Swedish Civ: Ingelmark, B. E., and Thord Lewin. 1968. "Anthropometrical
(Women) Studies on Swedish Women," Acta Morphologica, Vol. VII, No. 2, pp. 145-178.

Japanese Civ: Yanagisawa, Sumiko. 1974. About Japanese Physique and Body
(Men & Women) Girth (in Japanese), Tokyo, Japan: Department of Home Economics, Ochanomizu Institute, Women's University, Bunkyo-Ku.

USAF Flying Unpublished United States Air Force Systems Command Anthro-
Personnel: metric Data of Flying Personnel, furnished to Webb Associates
(Men) Inc., Yellow Springs, Ohio by the Aerospace Medical Research Laboratories, Wright Patterson Air Force Base, Ohio, 1967.

NASA Astro- Unpublished National Aeronautics and Space Administration
nauts: - Astronaut Anthropometric Data, furnished to Webb Associ-
(Men) ates, Inc., Yellow Springs, Ohio by John T. Jackson, NASA Lyndon B. Johnson Space Center, Man-Machine Engineering Section, Houston, Texas, 1976.

Roth, E. M., "Anthropometry and Temporo-Spatial Environment," Volume III, Section 16 in Compendium of Human Responses to the Aerospace Environment. 1968. Washington, D.C.: National Aeronautics and Space Administration, NASA CR-1205(III).

RAF Flying Bolton, C. B., M. Kenward, R. E. Simpson, and G. M. Turner.
Personnel: 1973. An Anthropometric Survey of 2000 Royal Air Force Air-
(Male) crew, 1970/1971, Royal Aircraft Establishment Technical Report 73083, Procurement Executive, Ministry of Defense, Farnborough, Hants, England.

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| Italian Military:
(Men) | Hertzberg, H. T. E., Edmund Churchill, C. Wesley Dupertuis, Robert M. White, and Albert Damon. 1963. <u>Anthropometric Survey of Turkey, Greece and Italy</u> , New York: The Macmillan Company. |
| French Fliers:
(Men) | Anonymous. 1973. <u>Etude Anthropometrique des Personnels Militaires des Armees</u> (French text). Anthropologie Appliquee, 45 rue des Saints-Peres, Paris 6e, France. |
| German Air Force:
(Men) | Grunhofer, H. J., and G. Kroh (eds.). 1975. <u>A Review of Anthropometric Data of German Air Force and United States Air Force Flying Personnel 1967-1968</u> , AGARDograph No. 205, Advisory Group for Aerospace Research and Development, North Atlantic Treaty Organization, Neuilly sur Seine, France. |

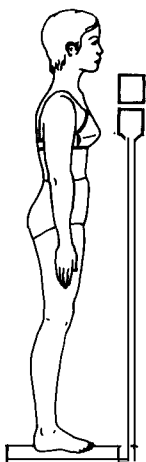
It should be noted that the publication date of the reference does not always coincide with the survey date (e.g., the anthropometric data on USAF women were measured during the spring and summer months of 1968, but the report was published in 1970). When we were able to ascertain the survey date, it has been included on each individual data page.

It will readily become apparent to the user of the anthropometric data that we do not have information on every anthropometric dimension for each of our selected 12 samples. As has been noted, every survey is planned around a somewhat different set of dimensions, and seldom if ever do such lists coincide. Table 1 summarizes the anthropometric data available for the sample populations.

On each of the 59 data pages, the text supplies the name of the dimension, an illustrative sketch, a brief description of the measurement and a guide to its possible applications. Data tabulated for each dimension include: the date of the study, the sample size, the age range of the sample, and the mean, standard deviation and 5th and 95th percentile values in both centimeters and inches for that dimension.

Measurement of the body requires the use of landmarks and anatomical terminology that may not be familiar to the user of this handbook. A glossary of such terms has, therefore, been included as Appendix A to this chapter. The reader is referred to Volume II for data on a much expanded list of dimensions and populations.

Drawings in the following section are illustrative; where there appears to be any discrepancy between the drawing and the measurement definition the written definition should be considered the more accurate.



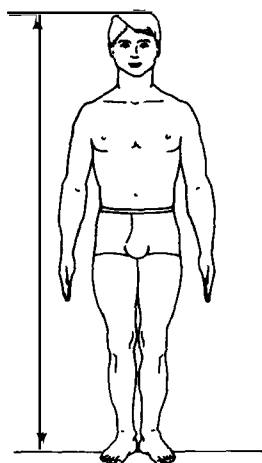
WEIGHT

Definition: Nude body weight as measured on physician's scales.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout;
Body linkage and models;
Equipment design: structural support for seats, platforms, couches, and body-restraint systems and harness rigging.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	57.73 (127.27)	7.52 (16.58)	46.4 (102.3)	70.9 (156.3)
U.S. HEW Civ.	1960-62	1165	25-40	62.38 (137.52)	14.26 (31.44)	46.0 (101.4)	89.4 (197.1)
British Civ.	1957	4989	18-55+	60.40 (133.15)	10.00 (22.05)	46.6 (102.7)	79.4 (175.0)
Swedish Civ.	1968	210	20-49	59.26 (130.64)	6.65 (14.66)	48.3 (106.5)	70.2 (154.8)
Japanese Civ.	1967-68 1972-73	1622	25-39	51.30 (113.09)	7.00 (15.43)	39.8 (87.7)	62.8 (138.4)
MALES							
USAF Flying Personnel	1967	2420	21-50	78.74 (173.58)	9.72 (21.43)	63.6 (140.2)	95.6 (210.8)
NASA Astro-nauts	Dates Vary	59	28-43	74.51 (164.26)	6.92 (15.26)	65.1 (143.5)	87.3 (192.5)
RAF Flying Personnel	1970-71	1998	18-45	75.04 (165.43)	8.81 (19.42)	61.4 (135.4)	90.3 (199.1)
Italian Military	1960	1342	18-59	70.25 (154.87)	8.42 (18.56)	57.6 (127.0)	85.1 (187.6)
French Fliers	1973	65	27-32	74.0 (163.1)	8.10 (17.9)	60.6 (133.6)	88.3 (194.7)
German AF	1975	1004	Not Reported	74.73 (164.74)	8.10 (17.86)	62.2 (137.1)	88.8 (195.8)
Japanese Civ.	1967-68 1972-73	1870	25-39	60.20 (132.71)	8.60 (18.96)	46.1 (101.6)	74.3 (163.8)

*Data given in kilograms with pounds in parentheses.



STATURE

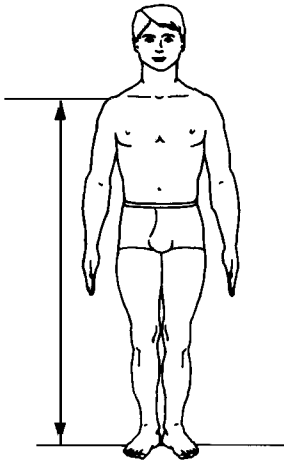
Definition: The vertical distance from the standing surface to the top of the head. The subject stands erect and looks straight ahead.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout-specifically, clearances;
Body linkage and models;
Equipment design: vertical clearances of workspaces and living quarters as well as prone or supine clearance of beds, litters, etc.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	162.1 (63.8)	6.0 (2.4)	152.4 (60.0)	172.1 (67.8)
U.S. HEW Civ.	1960-62	1165	25-40	161.7 (63.7)	6.3 (2.5)	151.3 (59.6)	171.9 (67.7)
British Civ.	1957	4995	18-55+	160.1 (63.0)	6.6 (2.6)	149.5 (58.9)	171.2 (67.4)
Swedish Civ.	1968	215	20-49	164.7 (64.8)	6.1 (2.4)	154.6 (60.9)	174.7 (68.8)
Japanese Civ.	1967-68 1972-73	1622	25-39	153.2 (60.3)	4.8 (1.9)	145.3 (57.2)	161.1 (63.4)
MALES							
USAF Flying Personnel	1967	2420	21-50	177.3 (69.8)	6.2 (2.4)	167.2 (65.8)	187.7 (73.9)
NASA Astro- nauts	Dates Vary	60	28-43	176.4 (69.4)	4.7 (1.9)	167.4 (65.9)	182.8 (72.0)
RAF Flying Personnel	1970-71	2000	18-45	177.4 (69.8)	6.2 (2.4)	167.3 (67.4)	187.8 (73.9)
Italian Military	1960	1342	18-59	170.8 (67.2)	6.2 (2.4)	160.2 (63.1)	180.8 (71.2)
French Fliers	1973	65	27-32	175.6 (69.1)	5.3 (2.1)	166.9 (65.7)	184.6 (72.7)
German AF	1975	1004	Not Reported	176.7 (69.6)	6.2 (2.4)	166.8 (65.7)	187.1 (73.7)
Japanese Civ.	1967-68 1972-73	1870	25-39	165.3 (65.1)	5.8 (2.3)	155.8 (61.3)	174.8 (68.8)

*Data given in centimeters with inches in parentheses.

ACROMIAL (SHOULDER) HEIGHT



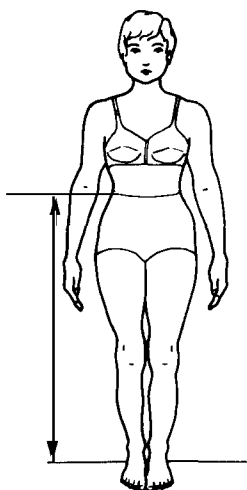
Definition: The vertical distance from the standing surface to the most lateral point of the acromial process of the scapula. The subject stands erect and looks straight ahead.

Application: General body description;
Workspace layout;
Body linkage models.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	131.9 (51.9)	5.5 (2.2)	123.0 (48.4)	141.1 (55.6)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.	1968	215	20-49	133.8 (52.7)	4.5 (1.8)	126.4 (49.8)	141.1 (55.6)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21- 50	145.2 (57.2)	5.8 (2.3)	135.7 (53.4)	154.8 (60.9)
NASA Astro-nauts	Dates Vary	53	28-43	144.2 (56.8)	4.3 (1.7)	136.7 (53.8)	150.9 (59.4)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	138.9 (54.7)	5.7 (2.2)	129.4 (50.9)	148.2 (58.3)
French Fliers	1973	65	27-32	144.7 (57.0)	5.0 (2.0)	136.3 (53.7)	152.5 (60.0)
German AF	1975	1004	Not Reported	147.2 (58.0)	5.8 (2.3)	137.6 (54.2)	156.9 (61.8)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

WAIST HEIGHT



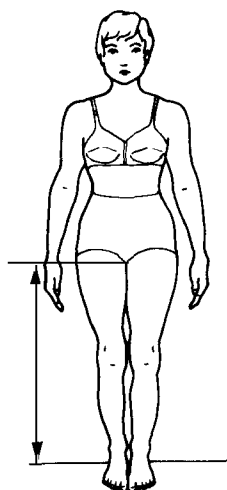
Definition: The vertical distance from the standing surface to the waist landmark. The subject stands erect and looks straight ahead.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout;
Equipment design: height of work surface for standing operation.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	100.3 (39.5)	4.5 (1.8)	93.1 (36.7)	107.9 (42.5)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.	1968	214	20-49	98.2 (38.7)	4.1 (1.6)	91.5 (36.0)	104.8 (41.3)
Japanese Civ.	1967-68 1972-73	1622	25-39	93.2 (36.7)	3.7 (1.5)	87.1 (34.3)	99.3 (39.1)
MALES							
USAF Flying Personnel	1967	2420	21-50	106.5 (41.9)	4.7 (1.9)	98.7 (38.9)	114.3 (45.0)
NASA Astronauts	Dates Vary	57	28-43	106.8 (42.0)	3.7 (1.5)	100.7 (39.6)	113.8 (44.8)
RAF Flying Personnel	1970-71	1662	18-45	107.4 (42.3)	5.1 (2.0)	99.2 (39.1)	116.1 (45.7)
Italian Military	1960	1342	18-59	101.3 (39.9)	4.9 (1.9)	93.0 (36.6)	109.2 (43.0)
French Fliers							
German AF	1975	1004	Not Reported	106.6 (42.0)	4.8 (1.9)	98.9 (38.9)	114.6 (45.1)
Japanese Civ.	1967-68 1972-73	1870	25-39	96.2 (37.9)	4.1 (1.6)	89.5 (35.2)	102.9 (40.5)

*Data given in centimeters with inches in parentheses.

CROTCH HEIGHT



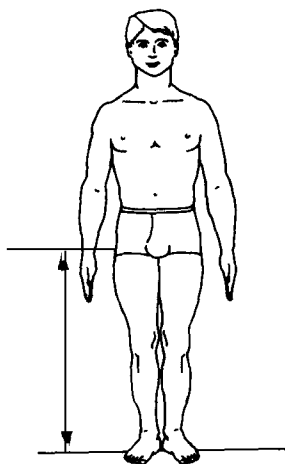
Definition: The vertical distance from the standing surface up into the crotch until light contact is made. The subject stands erect, heels approximately 10 cm. apart, and weight distributed equally on both feet.

Application: Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	74.5 (29.3)	4.0 (1.6)	68.1 (26.8)	81.4 (32.0)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.	1967-68 1972-73	1622	25-39	68.3 (26.9)	3.3 (1.3)	62.9 (24.8)	73.7 (29.0)
MALES							
USAF Flying Personnel	1967	2420	21-50	85.1 (33.5)	4.2 (1.7)	78.3 (30.8)	92.0 (36.2)
NASA Astro- nauts	Dates Vary	60	28-43	83.5 (32.9)	3.0 (1.2)	78.6 (30.9)	88.7 (34.9)
RAF Flying Personnel	1970-71	2000	18-45	85.4 (33.6)	4.3 (1.7)	78.4 (30.9)	92.5 (36.4)
Italian Military	1960	1342	18-59	80.7 (31.8)	4.2 (1.7)	73.6 (29.0)	87.6 (34.5)
French Fliers	1973	65	27-32	81.8 (32.2)	3.3 (1.3)	76.9 (30.3)	87.8 (34.6)
German AF	1975	1004	Not Reported	83.8 (33.0)	4.2 (1.7)	76.9 (30.3)	90.8 (35.7)
Japanese Civ.	1967-68 1972-73	1870	25-39	73.6 (29.0)	3.7 (1.5)	67.5 (26.6)	79.7 (31.4)

*Data given in centimeters with inches in parentheses.

TROCHANTERIC HEIGHT



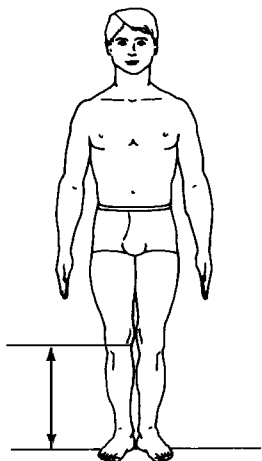
Definition: The vertical distance from the standing surface to the most superior point of the greater trochanter of the femur. The subject stands erect looking straight ahead, heels together and weight distributed equally on both feet.

Application: Body linkage and models.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	82.7 (32.6)	4.3 (1.7)	75.7 (29.8)	89.8 (35.4)
U.S. HEW Civ.							
British Civ.	1957	4995	18-55+	80.4 (31.7)	4.4 (1.7)	73.3 (28.9)	87.7 (34.5)
Swedish Civ.	1968	215	20-49	83.6 (32.9)	4.0 (1.6)	77.0 (30.3)	90.2 (35.5)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	94.0 (37.0)	4.4 (1.7)	86.9 (34.2)	101.3 (39.9)
NASA Astronauts	Dates Vary	56	28-43	92.0 (36.2)	3.3 (1.3)	87.1 (34.3)	97.8 (38.5)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	88.8 (35.0)	4.4 (1.7)	81.5 (32.1)	96.0 (37.8)
French Fliers	1973	65	27-32	92.2 (36.3)	3.6 (1.4)	86.6 (34.1)	98.5 (38.8)
German AF	1975	1004	Not Reported	91.8 (36.1)	4.6 (1.8)	84.2 (33.)	99.5 (39.2)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

TIBIALE HEIGHT



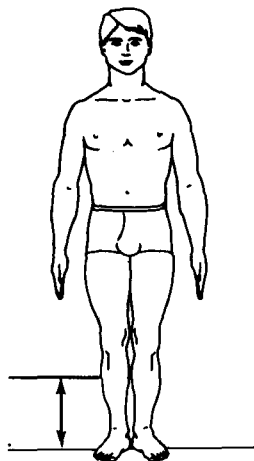
Definition: The vertical distance from the standing surface to the proximal medial margin of the tibia. The subject stands erect, heels together and weight distributed equally on both feet.

Application: Body linkage and models.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	42.0 (16.5)	2.4 (0.9)	38.2 (15.0)	46. (18.)
U.S. HEW Civ.							
British Civ.	1957	4995	18-55+	43.0 (16.9)	2.7 (1.1)	38.7 (15.2)	47.5 (18.7)
Swedish Civ.	1968	214	20-49	43.9 (17.3)	4.6 (1.8)	36.4 (14.3)	51.4 (20.2)
Japanese Civ.	1967-68 1972-73	1622	25-39	38.6 (15.2)	1.8 (0.7)	35.6 (14.0)	41.6 (16.4)
MALES							
USAF Flying Personnel							
NASA Astro- nauts	Dates Vary	24	28-43	46.6 (18.3)	1.7 (0.7)	43.8 (17.2)	49.4 (19.4)
RAF Flying Personnel							
Italian Military							
French Fliers	1973	65	27-32	46.2 (18.2)	2.0 (0.8)	42.8 (16.9)	49.0 (19.3)
German AF							
Japanese Civ.	1967-68 1972-73	1870	25-39	42.1 (16.6)	2.0 (0.8)	38.8 (15.3)	45.4 (17.9)

*Data given in centimeters with inches in parentheses.

CALF HEIGHT



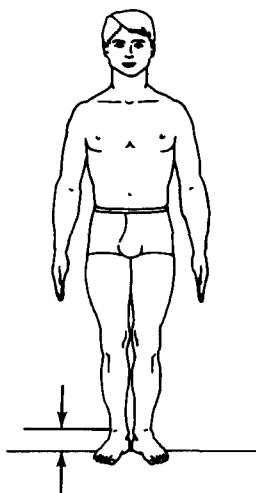
Definition: The vertical distance from the standing surface to the maximum posterior protrusion of the gastrocnemius. The subject stands erect, heels together and weight distributed equally on both feet.

Application: Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women							
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	35.6 (14.0)	2.2 (0.9)	32.0 (12.6)	39.3 (15.5)
NASA Astro- nauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	34.6 (13.6)	2.1 (0.8)	31.2 (12.3)	38.1 (15.0)
French Fliers							
German AF	1975	1004	Not Reported	35.1 (13.8)	2.4 (0.9)	31.2 (12.3)	39.3 (15.5)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

ANKLE HEIGHT

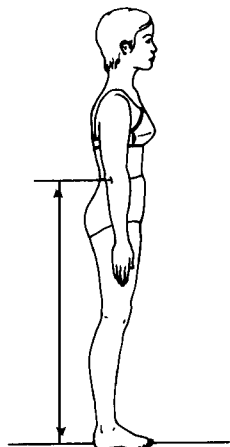


Definition: The vertical distance from the standing surface to the level of the minimum circumference of the ankle. The subject stands with his weight equally distributed on both feet.

Application: Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	11.2 (4.4)	1.4 (0.6)	9.2 (3.6)	13.6 (5.4)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	13.7 (5.4)	1.2 (0.5)	12.0 (4.7)	15.8 (6.2)
NASA Astronauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	12.9 (5.1)	0.6 (0.2)	11.9 (4.7)	13.9 (5.5)
French Fliers							
German AF							
Japanese Civ.							

*Data given in centimeters with inches in parentheses.



ELBOW HEIGHT

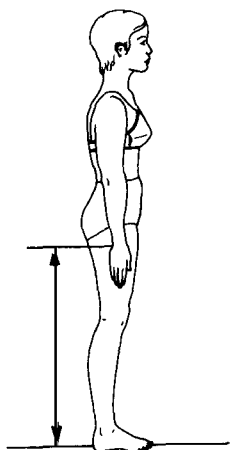
Definition: The vertical distance from the standing surface to the depression at the elbow between the humerus and the radius. The subject stands erect with his arms hanging naturally at his sides.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout;
Body linkage and models.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women							
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	112.3 (44.2)	4.6 (1.8)	104.8 (41.3)	120.0 (47.2)
NASA Astro-nauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	106.1 (41.8)	4.6 (1.8)	98.5 (38.8)	113.7 (44.8)
French Fliers							
German AF	1975	1004	Not Reported	110.9 (43.7)	4.5 (1.8)	103.6 (40.8)	118.6 (46.7)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

WRIST HEIGHT

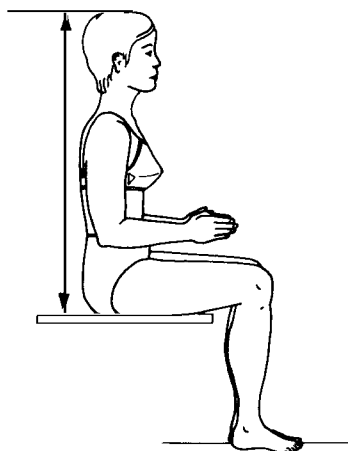


Definition: The vertical distance from the standing surface to the most distal point of the ulna. The subject stands erect with his arms hanging naturally at his sides.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout;
Body linkage and models.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women							
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	86.6 (34.1)	3.9 (1.5)	80.2 (31.6)	93.3 (36.7)
NASA Astro- nauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	81.5 (32.1)	3.7 (1.5)	75.4 (29.7)	87.6 (34.5)
French Eliers							
German AF	1975	1004	Not Reported	87.2 (34.3)	4.0 (1.6)	80.6 (31.7)	94.0 (37.0)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.



SITTING HEIGHT

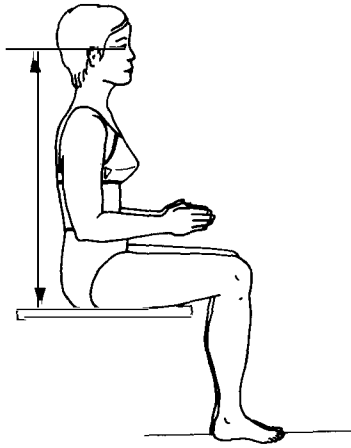
Definition: The vertical distance from the sitting surface to the top of the head. The subject sits erect, looking straight ahead.

Application: General body description;
Workspace layout;
Body linkage and models;
Equipment design: minimum vertical clearance from the seat surface of the seated operator.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	85.6 (33.7)	3.2 (1.3)	80.4 (31.7)	90.9 (35.8)
U.S. HEW Civ.	1960-62	1165	25-40	85.6 (33.7)	3.3 (1.3)	79.9 (31.5)	91.4 (36.0)
British Civ.							
Swedish Civ.	1968	214	20-49	87.3 (34.4)	3.0 (1.2)	82.3 (32.4)	92.2 (36.3)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	93.2 (36.7)	3.2 (1.3)	88.1 (34.7)	98.6 (38.8)
NASA Astronauts	Dates Vary	28	28-43	92.4 (36.4)	2.6 (1.0)	88.1 (34.7)	96.7 (38.1)
RAF Flying Personnel	1970-71	2000	18-45	93.6 (36.9)	3.1 (1.2)	88.4 (34.8)	98.6 (38.8)
Italian Military	1960	1342	18-59	89.7 (35.3)	3.2 (1.3)	84.3 (33.2)	94.8 (37.3)
French Fliers	1973	65	27-32	93.2 (36.7)	3.0 (1.2)	88.3 (34.8)	97.3 (38.3)
German AF	1975	1004	Not Reported	91.3 (35.9)	3.1 (1.2)	86.1 (33.9)	96.5 (38.0)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

EYE HEIGHT, SITTING



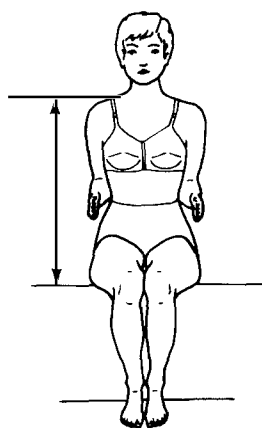
Definition: The vertical distance from the sitting surface to the outer corner (external canthus) of the eye. The subject sits erect and looks straight ahead.

Application: General body description;
Workspace layout;
Body linkage and models;
Equipment design: vertical distance from the seat surface to operator's eye position for optimum vision of workspace.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	73.7 (29.0)	3.1 (1.2)	68.7 (27.0)	78.8 (31.0)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	81.0 (31.9)	3.0 (1.2)	76.2 (30.0)	86.1 (33.9)
NASA Astronauts	Dates Vary	24	28-43	80.7 (31.8)	2.9 (1.1)	75.9 (29.9)	85.5 (33.7)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	78.0 (30.7)	3.0 (1.2)	73.1 (28.8)	82.9 (32.6)
French Fliers	1973	65	27-32	83.4 (32.8)	3.2 (1.3)	77.5 (30.5)	87.7 (34.5)
German AF	1975	1004	Not Reported	80.0 (31.5)	3.1 (1.2)	74.7 (29.4)	84.9 (33.4)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

MIDSHOULDER HEIGHT, SITTING



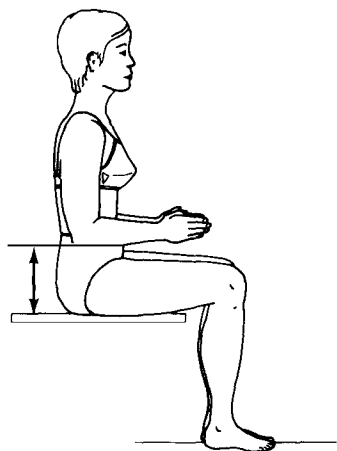
Definition: The vertical distance from the sitting surface to a point on the upper surface of the shoulder midway between the acromiale and the neck. The subject sits erect with his upper arms hanging relaxed and forearms and hands extended forward horizontally.

Application: Sizing of clothing;
Personal protective equipment;
Workspace layout;
Equipment design: placement of upper torso restraint for seated operator.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	58.0 (22.8)	2.7 (1.1)	53.7 (21.1)	62.5 (24.6)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	64.6 (25.4)	2.7 (1.1)	60.2 (23.7)	69.2 (27.2)
NASA Astro- nauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	61.3 (24.1)	2.6 (1.0)	57.1 (22.5)	65.6 (25.8)
French Fliers							
German AF	1975	1004	Not Reported	62.3 (24.5)	2.8 (1.1)	57.5 (22.6)	66.8 (26.3)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

ELBOW REST HEIGHT



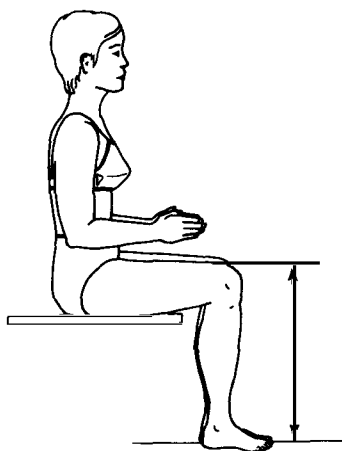
Definition: The vertical distance from the sitting surface to the bottom of the elbow. The subject sits erect with his upper arms hanging relaxed and forearms and hands extended forward horizontally.

Application: Workspace layout;
Equipment design: vertical distance from the seat surface to the top of the arm rest for the seated operator.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	22.7 (8.9)	2.5 (1.0)	18.7 (7.4)	26.9 (10.6)
U.S. HEW Civ.	1960-62	1165	25-40	23.6 (9.3)	2.8 (1.1)	18.9 (7.4)	28.4 (11.2)
British Civ.							
Swedish Civ.	1968	212	20-49	23.0 (9.1)	2.3 (0.9)	19.2 (7.6)	26.7 (10.5)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	25.2 (9.9)	2.6 (1.0)	20.9 (8.2)	29.5 (11.6)
NASA Astronauts							
RAF Flying Personnel	1970-71	2000	18-45	24.8 (9.8)	2.5 (1.0)	20.7 (8.1)	28.9 (11.4)
Italian Military	1960	1342	18-59	22.5 (8.9)	2.3 (0.9)	18.8 (7.4)	26.2 (10.3)
French Fliers	1973	65	27-32	25.6 (10.1)	2.2 (0.9)	22.0 (8.7)	28.8 (11.3)
German AF	1975	1004	Not Reported	23.9 (9.4)	2.7 (1.1)	19.3 (7.6)	28.4 (11.2)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

KNEE HEIGHT, SITTING



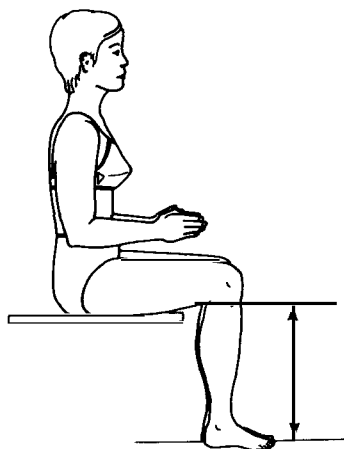
Definition: The vertical distance from the floor to the uppermost point on the knee. The subject sits erect with his knees and ankles at right angles.

Application: Workspace layout; Equipment design: vertical clearance from the floor to the underside of work surfaces and consoles for the seated operator.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women							
U.S. HEW Civ.	1960-62	1165	25-40	50.0 (19.7)	2.7 (1.1)	45.5 (17.9)	54.6 (21.5)
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	55.8 (22.0)	2.5 (1.0)	51.7 (20.4)	59.9 (23.6)
NASA Astro- nauts							
RAF Flying Personnel	1970-71	2000	18-45	55.9 (22.0)	2.5 (1.0)	51.9 (20.4)	60.3 (23.7)
Italian Military	1960	1342	18-59	53.4 (21.0)	2.6 (1.0)	49.2 (19.4)	57.9 (22.8)
French Fliers	1973	65	27-32	55.4 (21.8)	1.9 (0.7)	52.5 (20.7)	58.1 (22.9)
German AF	1975	1004	Not Reported	54.5 (21.5)	2.5 (1.0)	50.6 (19.9)	58.8 (23.1)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

POPLITEAL HEIGHT



Definition: The vertical distance from the floor to the underside of the thigh immediately behind the knee. The subject sits erect with his knees and ankles at right angles.

Application: Workspace layout;
Equipment design: vertical distance from the floor to the top forward edge of the seat pan for the seated operator.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	41.1 (16.2)	1.9 (0.7)	38.0 (15.0)	44.1 (17.)
U.S. HEW Civ.	1960-62	1165	25-40	40.0 (15.7)	2.6 (1.0)	35.8 (14.1)	44.3 (17.4)
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	43.7 (17.2)	2.3 (0.9)	40.1 (15.8)	47.5 (18.7)
NASA Astronauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	40.3 (15.9)	2.3 (0.9)	36.6 (14.4)	44.2 (17.4)
French Fliers	1973	65	27-32	45.6 (18.0)	1.5 (0.6)	42.6 (16.8)	47.7 (18.8)
German AF	1975	1004	Not Reported	43.8 (17.2)	2.1 (0.8)	40.4 (15.9)	47.4 (18.7)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

SHOULDER-ELBOW LENGTH



Definition: The distance from the top of the acromion process to the bottom of the elbow. The subject sits erect with his upper arms vertical and forearms and hands extended forward horizontally.

Application: Workspace layout;
Body linkage and models;
Equipment design: used in conjunction with shoulder height and shoulder height sitting to establish the vertical placement of work surfaces and controls.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women							
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	36.0 (14.2)	1.7 (0.7)	33.2 (13.1)	38.8 (15.3)
NASA Astronauts	Dates Vary	57	28-43	36.5 (14.4)	1.5 (0.6)	34.5 (13.6)	39.5 (15.6)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	35.6 (14.0)	1.7 (0.7)	32.9 (13.0)	38.5 (15.2)
French Fliers	1973	65	27-32	32.2 (12.7)	1.7 (0.7)	30.0 (11.8)	34.7 (13.7)
German AF	1975	1004	Not Reported	36.6 (14.4)	2.1 (0.8)	33.1 (13.0)	39.9 (15.7)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

FOREARM-HAND LENGTH

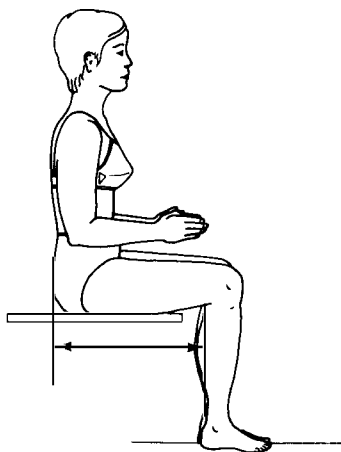


Definition: The distance from the tip of the elbow to the tip of the longest finger. The subject sits erect with his upper arms vertical and forearms and hands extended forward horizontally.

Application: Workspace layout;
Body linkage and models;
Equipment design: a minimum fingertip reach distance for workplace layout with the upper arm restrained.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women							
U.S. HEW Civ.							
British Civ.							
Swedish Civ.	1968	215	20-49	44.2 (17.4)	2.5 (1.0)	40.2 (15.8)	48.2 (19.0)
Japanese Civ.							
MALES							
USAF Flying Personnel							
NASA Astro- nauts	Dates Vary	28	28-43	47.6 (18.7)	2.0 (0.8)	44.3 (17.4)	50.9 (20.0)
RAF Flying Personnel	1970-71	1999	18-45	48.0 (18.9)	2.0 (0.8)	44.7 (17.6)	51.4 (20.2)
Italian Military							
French Fliers							
German AF							
Japanese Civ.							

*Data given in centimeters with inches in parentheses.



BUTTOCK-POPLITEAL LENGTH

Definition: The horizontal distance from the most posterior aspect of the right buttock to the back of the lower leg at the knee. The subject sits erect with his knees and ankles at right angles.

Application: Workspace layout;
Body linkage and models;
Equipment design: horizontal distance from the rear to the front edge of the seat pan to accommodate the thigh length of the seated operator.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	47.7 (18.8)	2.8 (1.1)	43.5 (17.1)	52.6 (20.7)
U.S. HEW Civ.	1960-62	1165	25-40	48.1 (18.9)	3.1 (1.2)	43.0 (16.9)	53.6 (21.1)
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	50.4 (19.8)	2.6 (1.0)	46.1 (18.1)	54.6 (21.5)
NASA Astronauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	48.0 (18.9)	2.5 (1.0)	44.1 (17.4)	52.2 (20.6)
French Fliers	1973	65	27-32	49.0 (19.3)	2.0 (0.8)	46.3 (18.2)	52.0 (20.5)
German AF	1975	1004	Not Reported	48.9 (19.3)	2.5 (1.0)	44.8 (17.6)	53.0 (20.9)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.



BUTTOCK-KNEE LENGTH

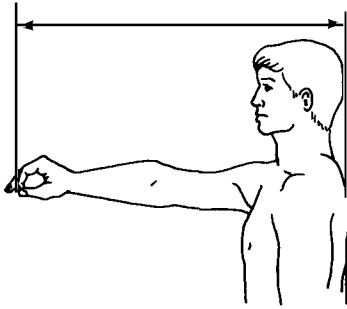
Definition: The horizontal distance from the most posterior aspect of the right buttock to the most anterior aspect of the right kneecap. The subject sits erect with his knees and ankles at right angles.

Application: Workspace layout;
Body linkage and models;
Equipment design: horizontal clearance from the front surface of the seat back rest to accommodate the upper leg length of the seated operator.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	57.4 (22.6)	2.6 (1.0)	53.2 (20.9)	61.9 (24.4)
U.S. HEW Civ.	1960-62	1165	25-40	57.1 (22.5)	3.1 (1.2)	52.0 (20.5)	62.8 (24.7)
British Civ.							
Swedish Civ.	1968	215	20-49	58.6 (23.1)	3.1 (1.2)	53.6 (21.1)	63.6 (25.0)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	60.4 (23.8)	2.7 (1.1)	56.1 (22.1)	65.0 (25.6)
NASA Astronauts	Dates Vary	23	28-43	60.4 (23.8)	1.5 (0.6)	57.9 (22.8)	62.9 (24.8)
RAF Flying Personnel	1970-71	2000	18-45	60.8 (23.9)	2.7 (1.1)	56.4 (22.2)	65.2 (25.7)
Italian Military	1960	1342	18-59	58.2 (22.9)	2.6 (1.0)	54.1 (21.3)	62.6 (24.6)
French Fliers	1973	65	27-32	59.5 (23.4)	2.2 (0.9)	56.3 (22.2)	63.1 (24.8)
German AF	1975	1004	Not Reported	60.2 (23.7)	2.6 (1.0)	56.0 (22.0)	64.6 (25.4)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

THUMB-TIP REACH



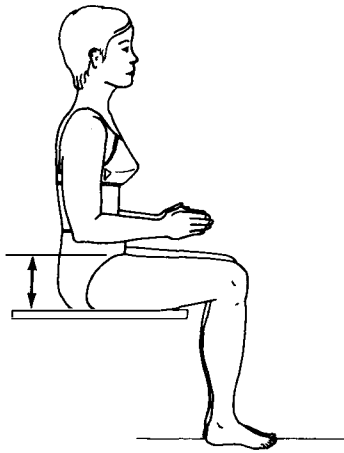
Definition: The horizontal distance from the wall to the tip of the thumb, measured with the subject's back against the wall, his arm extended forward, and his index finger touching the tip of his thumb.

Application: Workspace layout;
Equipment design: a minimum forward thumbtip reach distance with shoulder and torso restrained.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	74.1 (29.2)	3.9 (1.5)	67.7 (26.7)	80.5 (31.7)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	80.3 (31.6)	4.0 (1.6)	73.9 (29.1)	87.0 (34.3)
NASA Astro-nauts							
RAF Flying Personnel	1970-71	1997	18-45	80.2 (31.6)	3.6 (1.4)	74.4 (29.3)	85.1 (33.5)
Italian Military	1960	1342	18-59	75.3 (29.6)	3.7 (1.5)	69.3 (27.3)	81.6 (32.1)
French Fliers							
German AF	1975	1004	Not Reported	80.0 (31.5)	4.3 (1.7)	73.1 (28.8)	87.1 (34.3)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

THIGH CLEARANCE



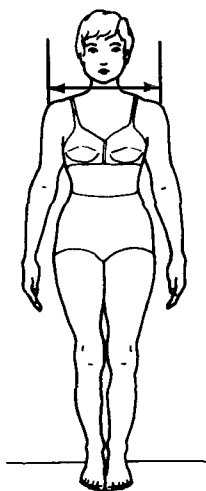
Definition: The vertical distance from the sitting surface to the highest point on the right thigh. The subject sits erect with his knees and ankles at right angles.

Application: Workspace layout;
Equipment design: vertical clearance from the top of the seat surface to the underside of work tables and consoles for the seated operator.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	12.4 (4.9)	1.3 (0.5)	10.4 (4.1)	14.6 (5.7)
U.S. HEW Civ.	1960-62	1165	25-40	13.9 (5.5)	1.9 (0.7)	10.7 (4.2)	17.8 (7.0)
British Civ.							
Swedish Civ.	1968	214	20-49	15.4 (6.1)	1.3 (0.5)	13.2 (5.2)	17.5 (6.9)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	16.5 (6.5)	1.4 (0.6)	14.3 (5.6)	18.8 (7.4)
NASA Astronauts							
RAF Flying Personnel	1970-71	588	18-45	15.8 (6.2)	1.2 (0.5)	13.9 (5.5)	17.8 (7.0)
Italian Military	1960	1342	18-59	16.1 (6.3)	1.1 (0.4)	14.4 (5.7)	18.0 (7.1)
French Fliers	1973	65	27-32	14.5 (5.7)	1.1 (0.4)	12.7 (5.0)	16.4 (6.5)
German AF	1975	1004	Not Reported	15.5 (6.1)	1.5 (0.6)	13.2 (5.2)	18.0 (7.1)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

BIACROMIAL BREADTH



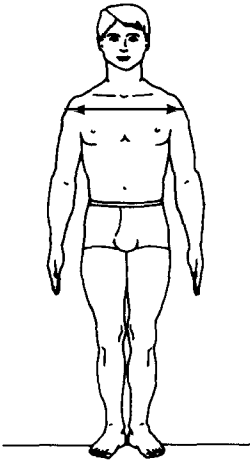
Definition: The horizontal distance across the body between the acromial landmarks. The subject stands erect with arms hanging naturally at her sides.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout;
Body linkage and models.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	35.8 (14.1)	1.6 (0.6)	33.2 (13.1)	38.6 (15.2)
U.S. HEW Civ.	1960-62	1165	25-40	35.7 (14.1)	1.9 (0.7)	32.3 (12.7)	39.1 (15.4)
British Civ.	1957	4995	18-55+	35.1 (13.8)	1.9 (0.7)	32.0 (12.6)	38.1 (15.0)
Swedish Civ.	1968	215	20-49	35.4 (13.9)	1.5 (0.6)	32.9 (13.0)	37.8 (14.9)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	40.7 (16.0)	1.9 (0.7)	37.5 (14.8)	43.8 (17.2)
NASA Astronauts	Dates Vary	52	28-43	40.5 (15.9)	1.7 (0.7)	38.0 (15.0)	43.5 (17.1)
RAF Flying Personnel	1970-71	2000	18-45	40.7 (16.0)	1.9 (0.7)	37.5 (14.8)	43.8 (17.2)
Italian Military	1960	1342	18-59	39.8 (15.7)	1.8 (0.7)	36.8 (14.5)	42.8 (16.9)
French Fliers	1973	65	27-32	39.9 (15.7)	1.8 (0.7)	37.0 (14.6)	42.6 (16.8)
German AF	1975	1004	Not Reported	38.5 (15.2)	2.4 (0.9)	34.3 (13.5)	42.3 (16.7)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

BIDELTOID (SHOULDER) BREADTH



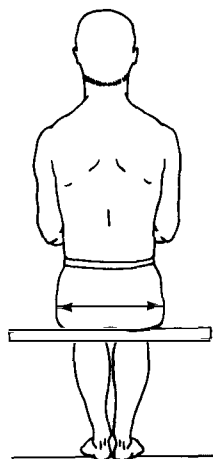
Definition: The horizontal distance across the body at the level of the deltoid landmarks. The subject stands erect with his arms hanging naturally at his sides.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout;
Body linkage and models;
Equipment design: clearance dimension of crawlway, hatches, and the like, and minimum breadth of cockpits and other workspaces.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	41.9 (16.5)	2.3 (0.9)	38.2 (15.0)	45.9 (18.1)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	48.2 (19.0)	2.6 (1.0)	44.1 (17.4)	52.6 (20.7)
NASA Astronauts	Dates Vary	56	28-43	48.0 (18.9)	1.9 (0.7)	44.6 (17.6)	51.0 (20.1)
RAF Flying Personnel	1970-71	1993	18-45	46.6 (18.3)	2.1 (0.8)	43.2 (17.0)	50.1 (19.7)
Italian Military	1960	1342	18-59	46.2 (18.2)	2.2 (0.9)	42.8 (16.9)	49.9 (19.6)
French Fliers	1973	65	27-32	47.6 (18.7)	2.1 (0.8)	43.4 (17.1)	50.6 (19.9)
German AF	1975	1004	Not Reported	46.2 (18.2)	2.4 (0.9)	42.4 (16.7)	50.2 (19.8)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

HIP BREADTH, SITTING



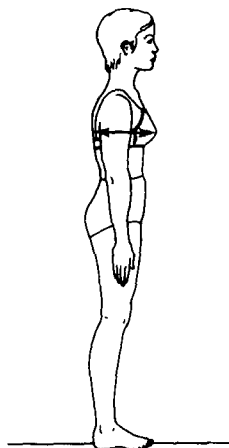
Definition: The maximum horizontal distance across the thighs. The subject sits erect, upper arms relaxed, forearms and hands extended forward horizontally, thighs completely supported by the sitting surface, and the long axis of the thighs parallel.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout;
Body linkage and models;
Equipment design: horizontal breadth of sitting support surfaces.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women							
U.S. HEW Civ.	1960-62	1165	25-40	36.4 (14.3)	3.7 (1.5)	31.1 (12.2)	43.3 (17.0)
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	37.8 (14.9)	2.3 (0.9)	34.2 (13.5)	41.8 (16.5)
NASA Astronauts	Dates Vary	27	28-43	36.5 (14.4)	1.5 (0.6)	34.0 (13.4)	39.0 (15.4)
RAF Flying Personnel	1970-71	2000	18-45	36.8 (14.5)	2.0 (0.8)	33.7 (13.3)	40.0 (15.7)
Italian Military	1960	1342	18-59	35.7 (14.1)	1.8 (0.7)	32.7 (12.9)	38.7 (15.2)
French Fliers	1973	65	27-32	36.8 (14.5)	1.9 (0.7)	33.9 (13.3)	39.5 (15.6)
German AF							
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

CHEST (BUST) DEPTH



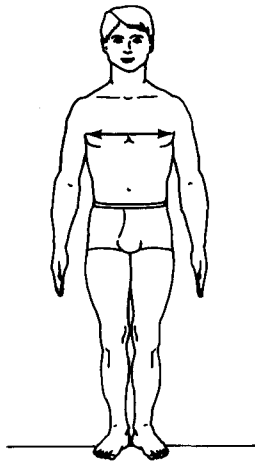
Definition: The horizontal depth of the trunk at the level of the nipples. The subject stands erect, looking straight ahead, heels together, and weight distributed equally on both feet.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	23.6 (9.3)	1.9 (0.7)	20.9 (8.2)	27.2 (10.7)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	24.5 (9.6)	1.9 (0.7)	21.3 (8.4)	27.7 (10.9)
NASA Astro- nauts	Dates Vary	28	28-43	24.0 (9.4)	1.6 (0.6)	21.4 (8.4)	26.6 (10.5)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	23.8 (9.4)	1.7 (0.7)	21.1 (8.3)	26.8 (10.6)
French Fliers	1973	65	27-32	25.1 (9.9)	1.7 (0.7)	22.7 (8.9)	28.0 (11.0)
German AF	1975	1004	Not Reported	23.2 (9.1)	2.0 (0.8)	20.1 (7.9)	26.7 (10.5)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

CHEST BREADTH



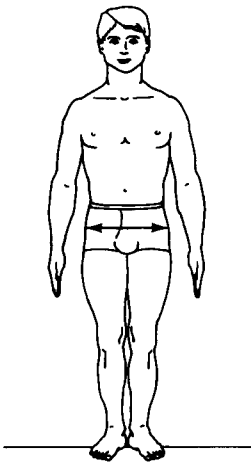
Definition: The horizontal distance across the trunk at the level of the nipples. The subject stands erect, looking straight ahead, with his arms slightly abducted.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout;
Equipment design: clearance breadth of torso-worn personal protective equipment such as respirator packs, rigid body armor, and back packs.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics *			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	28.0 (11.0)	1.9 (0.7)	25.1 (9.9)	31.4 (12.4)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.	1968	213	20-49	25.3 (10.0)	1.2 (0.5)	23.3 (9.2)	27.4 (10.8)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	32.8 (12.9)	2.1 (0.8)	29.5 (11.6)	36.5 (14.4)
NASA Astro-nauts	Dates Vary	57	28-43	32.1 (12.6)	1.9 (0.7)	29.3 (11.5)	35.6 (14.0)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	31.8 (12.5)	1.8 (0.7)	29.0 (11.4)	34.9 (13.7)
French Fliers	1973	65	27-32	32.1 (12.6)	1.9 (0.7)	29.0 (11.4)	35.7 (14.1)
German AF	1975	1004	Not Reported	31.3 (12.3)	2.3 (0.9)	27.7 (10.9)	35.4 (13.9)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

HIP BREADTH



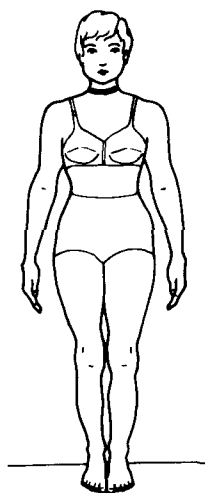
Definition: The maximum horizontal distance across the hips. The subject stands erect, heels together and weight distributed equally on both feet.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	35.0 (13.8)	2.2 (0.9)	31.6 (12.4)	38.8 (15.3)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	35.3 (13.9)	1.9 (0.7)	32.3 (12.7)	38.5 (15.2)
NASA Astronauts	Dates Vary	56	28-43	34.7 (13.7)	1.7 (0.7)	31.7 (12.5)	37.6 (14.8)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	34.2 (13.5)	1.7 (0.7)	31.5 (12.4)	37.1 (14.6)
French Fliers							
German AF	1975	1004	Not Reported	35.2 (13.9)	1.8 (0.7)	32.3 (12.7)	38.3 (15.1)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

NECK CIRCUMFERENCE

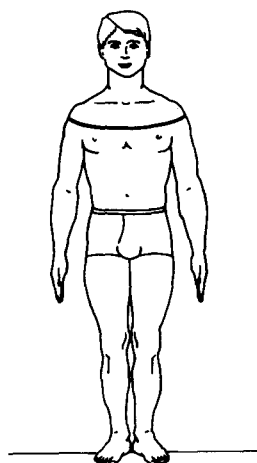


Definition: The maximum circumference of the neck at a point just inferior to the bulge of the thyroid cartilage. The subject sits erect, head in the Frankfort plane.

Application: General body description;
Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	33.8 (13.3)	1.7 (0.7)	31.1 (12.2)	36.7 (14.4)
U.S. HEW Civ.							
British Civ.	1957	4995	18-55+	38.4 (15.1)	2.0 (0.8)	35.3 (13.9)	41.7 (16.4)
Swedish Civ.							
Japanese Civ.	1967-68 1972-73	1622	25-39	37.1 (14.6)	1.7 (0.7)	34.3 (13.5)	39.9 (15.7)
MALES							
USAF Flying Personnel	1967	2420	21-50	38.3 (15.1)	1.9 (0.7)	35.4 (13.9)	41.7 (16.4)
NASA Astronauts	Dates Vary	50	28-43	38.2 (15.0)	1.8 (0.7)	35.0 (13.8)	41.1 (16.2)
RAF Flying Personnel	1970-71	2000	18-45	38.2 (15.0)	1.7 (0.7)	35.5 (14.0)	41.0 (16.1)
Italian Military	1960	1342	18-59	37.6 (14.8)	1.7 (0.7)	35.2 (13.9)	40.7 (16.0)
French Fliers	1973	65	27-32	37.9 (14.9)	2.0 (0.8)	34.9 (13.7)	41.0 (16.1)
German AF	1975	1004	Not Reported	38.1 (15.0)	1.7 (0.7)	35.4 (13.9)	41.2 (16.2)
Japanese Civ.	1967-68 1972-73	1870	25-39	36.0 (14.2)	1.9 (0.7)	32.9 (13.0)	39.1 (15.4)

*Data given in centimeters with inches in parentheses.



SHOULDER CIRCUMFERENCE

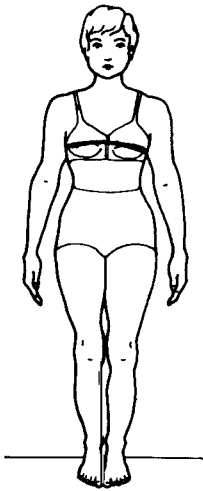
Definition: The horizontal circumference of the body over the deltoid muscles. The subject stands erect, looking straight ahead, arms relaxed at the sides, heels together, and weight distributed equally on both feet.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	100.4 (39.5)	5.1 (2.0)	92.6 (36.5)	109.4 (43.1)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	117.7 (46.3)	5.8 (2.3)	108.4 (42.7)	127.6 (50.2)
NASA Astro- nauts	Dates Vary	56	28-43	116.2 (45.7)	4.3 (1.7)	109.7 (43.2)	123.8 (48.7)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	112.8 (44.4)	5.0 (2.0)	105.0 (41.3)	121.4 (47.8)
French Fliers	1973	65	27-32	115.6 (45.5)	5.2 (2.0)	106.4 (41.9)	122.7 (48.3)
German AF	1975	1004	Not Reported	115.7 (45.6)	5.6 (2.2)	106.7 (42.0)	125.3 (49.3)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

CHEST CIRCUMFERENCE



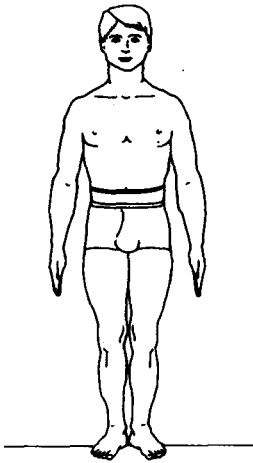
Definition: The horizontal circumference of the chest at the level of the nipples. The subject stands erect, looking straight ahead, heels together, and weight distributed equally on both feet.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout;
Equipment design: upper torso restraint systems and rigging.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	89.7 (35.3)	5.7 (2.2)	81.6 (32.1)	100.2 (39.4)
U.S. HEW Civ.	1960-62	1165	25-40	86.6 (34.1)	7.9 (3.1)	76.6 (30.2)	101.8 (40.1)
British Civ.	1957	4995	18-55+	92.7 (36.5)	8.7 (3.4)	81.5 (32.1)	109.6 (43.1)
Swedish Civ.	1968	215	20-49	86.0 (33.9)	4.6 (1.8)	78.5 (30.9)	93.4 (36.8)
Japanese Civ.	1967-68 1972-73	1622	25-39	83.6 (32.9)	6.4 (2.5)	73.1 (28.8)	94.1 (37.0)
MALES							
USAF Flying Personnel	1967	2420	21-50	98.6 (38.8)	6.4 (2.5)	88.6 (34.9)	109.4 (43.1)
NASA Astro-nauts	Dates Vary	53	28-43	97.1 (38.2)	4.8 (1.9)	90.1 (35.5)	107.1 (42.2)
RAF Flying Personnel	1970-71	1999	18-45	97.2 (38.3)	5.7 (2.2)	88.3 (34.8)	107.1 (42.2)
Italian Military	1960	1342	18-59	94.9 (37.4)	5.2 (2.0)	87.0 (34.3)	104.0 (40.9)
French Fliers	1973	65	27-32	96.0 (37.8)	5.8 (2.3)	86.6 (34.1)	104.1 (41.0)
German AF	1975	1004	Not Reported	94.7 (37.3)	6.3 (2.5)	84.7 (33.3)	105.3 (41.5)
Japanese Civ.	1967-68 1972-73	1870	25-39	88.1 (34.7)	5.3 (2.1)	79.4 (31.3)	96.8 (38.1)

*Data given in centimeters with inches in parentheses.

WAIST CIRCUMFERENCE

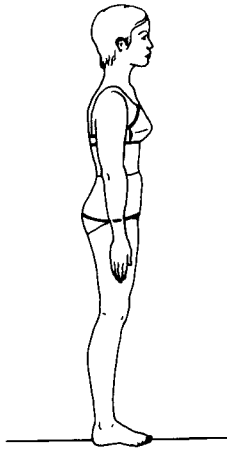


Definition: The horizontal circumference of the trunk at the level of the waist landmarks. Subject stands erect, looking straight ahead, heels together and weight distributed equally on both feet.

Application: General body description;
Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	67.2 (26.5)	5.5 (2.2)	59.5 (23.4)	77.2 (30.4)
U.S. HEW Civ.	1960-62	1165	25-40	73.6 (29.0)	11.0 (4.3)	60.9 (24.0)	95.1 (37.4)
British Civ.	1957	4995	18-55+	68.3 (26.9)	8.9 (3.5)	58.1 (22.9)	86.2 (33.9)
Swedish Civ.	1968	215	20-49	67.7 (26.7)	4.2 (1.7)	60.8 (23.9)	74.6 (29.4)
Japanese Civ.	1967-68 1972-73	1622	25-39	67.1 (26.4)	6.3 (2.5)	56.7 (22.3)	77.5 (30.5)
MALES							
USAF Flying Personnel	1967	2420	21-50	87.6 (34.5)	7.4 (2.9)	75.7 (29.8)	100.1 (39.4)
NASA Astronauts	Dates Vary	59	28-43	82.1 (32.3)	4.5 (1.8)	74.7 (29.4)	90.2 (35.5)
RAF Flying Personnel	1970-71	1662	18-45	85.7 (33.7)	7.0 (2.8)	74.7 (29.4)	97.8 (38.5)
Italian Military	1960	1342	18-59	82.4 (32.4)	7.1 (2.8)	72.3 (28.5)	95.3 (37.5)
French Fliers	1973	65	27-32	84.8 (33.4)	6.3 (2.5)	74.4 (29.3)	94.0 (37.0)
German AF	1975	1004	Not Reported	84.0 (33.1)	6.8 (2.7)	73.5 (28.9)	96.1 (37.8)
Japanese Civ.	1967-68 1972-73	1870	25-39	76.5 (30.1)	7.9 (3.1)	63.5 (25.0)	89.5 (35.2)

*Data given in centimeters with inches in parentheses.



BUTTOCK CIRCUMFERENCE

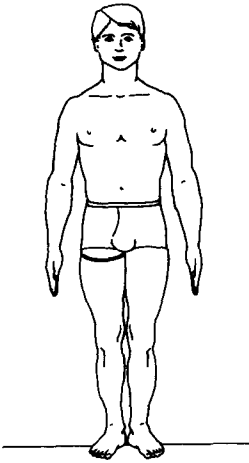
Definition: The circumference of the hips at the level of the maximum posterior protrusion of the buttocks. The subject stands erect, looking straight ahead, heels together, and weight distributed equally on both feet.

Application: General body description; Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	95.3 (37.5)	6.0 (2.4)	85.8 (33.8)	105.6 (41.6)
U.S. HEW Civ.							
British Civ.	1957	4994	18-55+	97.6 (38.4)	7.9 (3.1)	87.0 (34.3)	112.4 (44.3)
Swedish Civ.	1968	214	20-49	88.1 (34.7)	6.1 (2.4)	78.1 (30.7)	98.0 (38.6)
Japanese Civ.	1967-68 1972-73	1622	25-39	90.0 (35.4)	5.2 (2.0)	81.4 (32.0)	98.6 (38.8)
MALES							
USAF Flying Personnel	1967	2420	21-50	98.6 (38.8)	5.5 (2.2)	89.7 (35.3)	107.9 (42.5)
NASA Astro- nauts	Dates Vary	58	28-43	96.1 (37.8)	4.0 (1.6)	89.5 (35.2)	102.8 (40.5)
RAF Flying Personnel	1970-71	1999	18-45	98.9 (38.9)	5.0 (2.0)	90.8 (35.7)	107.3 (42.2)
Italian Military	1960	1342	18-59	95.1 (37.4)	4.9 (1.9)	87.3 (34.4)	103.4 (40.7)
French Fliers	1973	65	27-32	96.5 (38.0)	5.0 (2.0)	87.8 (34.6)	104.0 (40.9)
German AF	1975	1004	Not Reported	96.6 (38.0)	4.7 (1.9)	89.1 (35.1)	104.5 (41.1)
Japanese Civ.	1967-68 1972-73	1870	25-39	90.3 (35.6)	5.2 (2.0)	81.7 (32.2)	98.9 (38.9)

*Data given in centimeters with inches in parentheses.

THIGH CIRCUMFERENCE

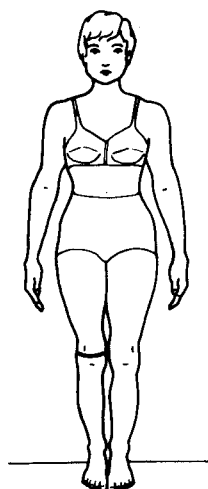


Definition: The circumference of the thigh at the level of the gluteal furrow. The subject stands erect, heels approximately 10 cm. apart, and weight distributed equally on both sides.

Application: General body description; Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	55.5 (21.9)	4.2 (1.7)	48.7 (19.2)	62.6 (24.6)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.	1968	215	20-49	56.3 (22.2)	4.7 (1.9)	48.7 (19.2)	64.0 (25.2)
Japanese Civ.	1967-68 1972-73	1622	25-39	51.5 (20.3)	3.8 (1.5)	45.2 (17.8)	57.8 (22.8)
MALES							
USAF Flying Personnel	1967	2420	21-50	58.8 (23.1)	4.4 (1.7)	51.5 (20.3)	66.2 (26.1)
NASA Astronauts	Dates Vary	57	28-43	56.9 (22.4)	2.9 (1.1)	52.3 (20.6)	61.8 (24.3)
RAF Flying Personnel	1970-71	2000	18-45	57.0 (22.4)	3.9 (1.5)	50.6 (19.9)	63.3 (24.9)
Italian Military	1960	1342	18-59	54.5 (21.5)	3.5 (1.4)	48.8 (19.2)	60.3 (23.7)
French Fliers	1973	65	27-32	55.8 (22.0)	3.8 (1.5)	48.2 (19.0)	62.0 (24.4)
German AF	1975	1004	Not Reported	55.9 (22.0)	3.5 (1.4)	50.3 (19.8)	61.7 (24.3)
Japanese Civ.	1967-68 1972-73	1870	25-39	50.3 (19.8)	3.9 (1.5)	43.9 (17.3)	56.7 (22.3)

*Data given in centimeters with inches in parentheses.



KNEE CIRCUMFERENCE

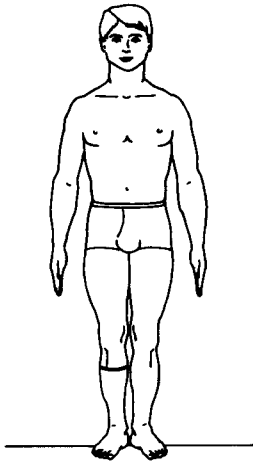
Definition: The circumference of the knee at the level of the midpatella landmark. The subject stands erect, heels approximately 10 cm. apart, and weight distributed equally on both feet.

Application: General body description;
Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	36.3 (14.3)	2.3 (0.9)	32.8 (12.9)	40.2 (15.8)
U.S. HEW Civ.							
British Civ.	1957	4994	18-55+	35.5 (14.0)	2.6 (1.0)	31.7 (12.5)	40.0 (15.7)
Swedish Civ.							
Japanese Civ.	1967-68 1972-73	1622	25-39	33.5 (13.2)	2.2 (0.9)	29.9 (11.8)	37.1 (14.6)
MALES							
USAF Flying Personnel	1967	2420	21-50	38.7 (15.2)	2.1 (0.8)	35.4 (13.9)	42.2 (16.6)
NASA Astro-nauts	Dates Vary	52	28-43	39.5 (15.6)	2.1 (0.8)	37.0 (14.6)	43.3 (17.0)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	38.1 (15.0)	1.9 (0.7)	35.1 (13.8)	41.5 (16.3)
French Fliers							
German AF	1975	1004	Not Reported	38.0 (15.0)	1.9 (0.7)	35.0 (13.8)	41.0 (16.1)
Japanese Civ.	1967-68 1972-73	1870	25-39	34.6 (13.6)	2.0 (0.8)	31.3 (12.3)	37.9 (14.9)

*Data given in centimeters with inches in parentheses.

CALF CIRCUMFERENCE



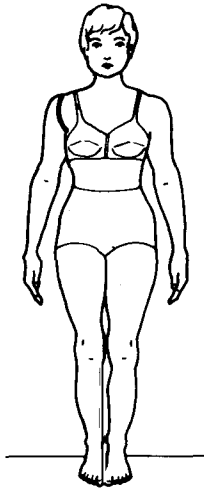
Definition: The maximum horizontal circumference of the calf. The subject stands erect, heels approximately 10 cm. apart, and weight distributed equally on both feet.

Application: General body description;
Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	_Descriptive Statistics*			
				X	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	34.1 (13.4)	2.3 (0.9)	30.6 (12.0)	37.9 (14.9)
U.S. HEW Civ.							
British Civ.	1957	4994	18-55+	34.6 (13.6)	2.6 (1.0)	30.6 (12.0)	39.1 (15.4)
Swedish Civ.	1968	212	20-49	35.4 (13.9)	2.6 (1.0)	31.1 (12.2)	39.7 (15.6)
Japanese Civ.	1967-68 1972-73	1622	25-39	33.3 (13.1)	2.3 (0.9)	29.5 (11.6)	37.1 (14.6)
MALES							
USAF Flying Personnel	1967	2420	21-50	37.2 (14.6)	2.3 (0.9)	33.5 (13.2)	41.0 (16.1)
NASA Astronauts	Dates Vary	57	28-43	38.3 (15.1)	2.1 (0.8)	34.8 (13.7)	41.7 (16.4)
RAF Flying Personnel	1970-71	2000	18-45	36.7 (14.4)	2.2 (0.9)	33.2 (13.1)	40.3 (15.9)
Italian Military	1960	1342	18-59	36.5 (14.4)	2.2 (0.9)	33.3 (13.1)	40.4 (15.9)
French Fliers	1973	65	27-32	36.8 (14.5)	2.2 (0.9)	32.4 (12.8)	40.0 (15.7)
German AF	1975	1004	Not Reported	37.1 (14.6)	2.2 (0.9)	33.5 (13.2)	40.7 (16.0)
Japanese Civ.	1967-68 1972-73	1870	25-39	34.9 (13.7)	2.6 (1.0)	30.6 (12.0)	39.2 (15.4)

*Data given in centimeters with inches in parentheses.

SCYE CIRCUMFERENCE

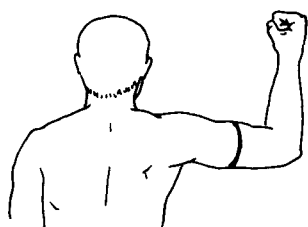


Definition: The circumference of the scye, passing through the axilla over the anterior and posterior vertical scye landmarks and over the acromial landmark. The subject stands erect, looking straight ahead, with the right arm slightly abducted.

Application: Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	37.1 (14.6)	2.3 (0.9)	33.6 (13.2)	41.1 (16.2)
U.S. HEW Civ.							
British Civ.	1957	4995	18-55+	39.8 (15.7)	3.3 (1.3)	35.2 (13.9)	45.9 (18.1)
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	48.4 (19.1)	2.8 (1.1)	43.8 (17.2)	53.0 (20.9)
NASA Astronauts	Dates Vary	53	28-43	45.8 (18.0)	2.0 (0.8)	42.9 (16.9)	49.2 (19.4)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	44.8 (17.6)	2.5 (1.0)	40.8 (16.1)	49.0 (19.3)
French Fliers	1973	65	27-32	43.3 (17.0)	2.1 (0.8)	39.9 (15.7)	47.0 (18.5)
German AF	1975	1004	Not Reported	45.9 (18.1)	3.6 (1.4)	40.4 (15.9)	52.2 (20.6)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.



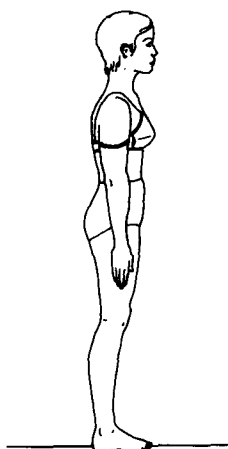
BICEPS CIRCUMFERENCE, FLEXED

Definition: The circumference of the arm at the level of the biceps landmark. The subject stands with his elbow bent at 90 degrees and the biceps maximally flexed.

Application: General body description;
Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	26.8 (10.6)	2.3 (0.9)	23.3 (9.2)	30.8 (12.1)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	32.7 (12.9)	2.3 (0.9)	29.1 (11.5)	36.6 (14.4)
NASA Astronauts	Dates Vary	56	28-43	33.3 (13.1)	1.8 (0.7)	30.8 (12.1)	36.9 (14.5)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	31.0 (12.2)	2.1 (0.8)	27.8 (10.9)	34.8 (13.7)
French Fliers	1973	65	27-32	31.9 (12.6)	2.0 (0.8)	28.3 (11.1)	35.1 (13.8)
German AF	1975	1004	Not Reported	32.2 (12.7)	2.2 (0.9)	28.6 (11.3)	35.9 (14.1)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.



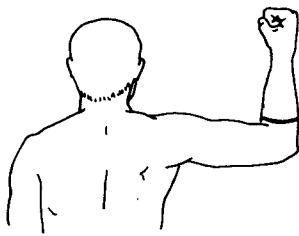
BICEPS CIRCUMFERENCE, RELAXED

Definition The circumference of the arm at the level of the biceps landmark. The subject stands with his arm slightly abducted.

Application: General body description;
Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	25.6 (10.1)	2.3 (0.9)	22.2 (8.7)	29.7 (11.7)
U.S. HEW Civ.	1960-62	1165	25-40	28.1 (11.1)	4.2 (1.7)	22.6 (8.9)	36.4 (14.3)
British Civ.	1957	4995	18-55+	28.6 (11.3)	3.2 (1.3)	24.1 (9.5)	34.5 (13.6)
Swedish Civ.	1968	214	20-49	27.7 (10.9)	3.0 (1.2)	22.8 (9.0)	32.5 (12.8)
Japanese Civ.	1967-68	1622	25-39	26.7 (10.5)	2.5 (1.0)	22.6 (8.9)	30.8 (12.1)
MALES							
USAF Flying Personnel	1967	2420	21-50	30.8 (12.1)	2.3 (0.9)	27.0 (10.6)	34.7 (13.7)
NASA Astronauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	29.3 (11.5)	2.2 (0.9)	26.0 (10.2)	33.0 (13.0)
French Fliers	1973	65	27-32	29.5 (11.6)	2.0 (0.8)	26.0 (10.2)	33.1 (13.0)
German AF	1975	1004	Not Reported	29.3 (11.5)	2.0 (0.8)	25.9 (10.2)	32.7 (12.9)
Japanese Civ.	1967-68 1972-73	1870	25-39	27.5 (10.8)	2.4 (0.9)	23.6 (9.3)	31.4 (12.4)

*Data given in centimeters with inches in parentheses.



FOREARM CIRCUMFERENCE, FLEXED

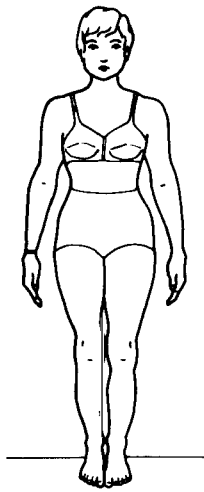
Definition: The circumference of the arm at the level of the forearm landmark. The subject stands with his upper arm raised so that its long axis is horizontal, elbow flexed 90 degrees and fist tightly clenched.

Application: Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	25.0 (9.8)	1.5 (0.6)	22.6 (8.9)	27.5 (10.8)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	29.8 (11.7)	1.6 (0.6)	27.2 (10.7)	32.4 (12.8)
NASA Astro-nauts	Dates Vary	55	28-43	29.2 (11.5)	1.6 (0.6)	26.6 (10.5)	31.7 (12.5)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	29.0 (11.4)	1.6 (0.6)	26.4 (10.4)	31.7 (12.5)
French Fliers	1973	65	27-32	28.2 (11.1)	1.1 (0.4)	26.3 (10.4)	29.8 (11.7)
German AF	1975	1004	Not Reported	29.5 (11.6)	2.0 (0.8)	26.3 (10.4)	32.9 (13.0)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

WRIST CIRCUMFERENCE



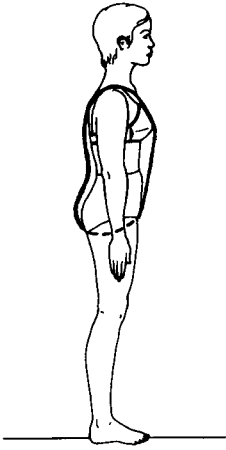
Definition: The minimum circumference of the wrist at the level of the stylium landmark. The subject stands with the arm slightly abducted.

Application: Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	15.0 (5.9)	0.7 (0.3)	13.8 (5.4)	16.2 (6.4)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.	1968	215	20-49	16.3 (6.4)	0.9 (0.4)	14.8 (5.8)	17.7 (7.0)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	17.6 (6.9)	0.9 (0.4)	16.2 (6.4)	19.2 (7.6)
NASA Astro-nauts	Dates Vary	57	28-43	17.3 (6.8)	0.8 (0.3)	16.0 (6.3)	18.7 (7.4)
RAF Flying Personnel	1970-71	1999	18-45	17.4 (6.9)	1.0 (0.4)	15.9 (6.3)	19.1 (7.5)
Italian Military	1960	1342	18-59	17.4 (6.9)	0.9 (0.4)	16.0 (6.3)	18.9 (7.4)
French Fliers	1973	65	27-32	16.9 (6.7)	0.8 (0.3)	15.8 (6.2)	18.5 (7.3)
German AF	1975	1005	Not Reported	17.8 (7.0)	0.9 (0.4)	16.4 (6.5)	19.4 (7.6)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

VERTICAL TRUNK CIRCUMFERENCE

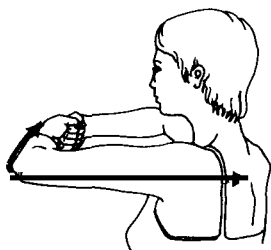


Definition: The circumference of the trunk measured by passing a tape between the legs, over the protrusion of the right buttock, and up the back to lie over the midshoulder landmark. The other end of the tape is brought up over the right nipple to the midshoulder landmark. The subject stands with the legs slightly apart.

Application: Sizing of clothing and personal protective equipment;
Equipment design: length of straps and webbing for restraint systems and rigging.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	154.4 (60.8)	6.9 (2.7)	143.5 (56.5)	166.3 (65.5)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.	1967-68 1972-73	1622	25-39	147.7 (58.1)	5.9 (2.3)	138.0 (54.3)	157.4 (62.0)
MALES							
USAF Flying Personnel	1967	2420	21-50	168.1 (66.2)	7.2 (2.8)	156.7 (61.7)	180.2 (70.9)
NASA Astro-nauts	Dates Vary	58	28-43	168.4 (66.3)	7.1 (2.8)	157.6 (62.0)	181.0 (71.3)
RAF Flying Personnel	1970-71	2000	18-45	162.5 (64.0)	6.6 (2.6)	151.8 (59.8)	173.4 (68.3)
Italian Military	1960	1342	18-59	160.5 (63.2)	6.3 (2.5)	150.5 (59.3)	171.2 (67.4)
French Fliers	1973	65	27-32	159.5 (62.8)	6.4 (2.5)	149.7 (58.9)	169.2 (66.6)
German AF	1975	1004	Not Reported	165.5 (65.2)	6.9 (2.7)	154.7 (60.9)	177.4 (69.8)
Japanese Civ.	1967-68 1972-73	1870	25-39	158.9 (62.6)	7.4 (2.9)	146.7 (57.8)	171.1 (67.4)

*Data given in centimeters with inches in parentheses.



SPINE-TO-WRIST LENGTH (SLEEVE LENGTH)

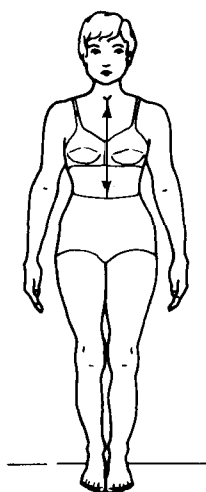
Definition: The surface distance from the spine to the wrist landmark. The subject stands, arms horizontal, elbows flexed about 60 degrees, fists clenched and touching, and shoulders relaxed.

Application: Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	79.6 (31.3)	3.3 (1.3)	74.2 (29.2)	85.1 (33.5)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.	1967-68 1972-73	1622	25-39	68.7 (27.0)	2.5 (1.0)	64.6 (25.4)	72.8 (28.7)
MALES							
USAF Flying Personnel	1967	2420	21-50	90.8 (35.7)	3.5 (1.4)	85.2 (33.5)	96.8 (38.1)
NASA Astro-nauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	85.3 (33.6)	3.5 (1.4)	79.6 (31.3)	91.1 (35.9)
French Fliers	1973	65	27-32	86.6 (34.1)	2.8 (1.1)	82.1 (32.3)	90.7 (35.7)
German AF	1975	1004	Not Reported	87.4 (34.4)	3.8 (1.5)	81.2 (32.0)	93.7 (36.9)
Japanese Civ.	1968-68 1972-73	1870	25-39	74.6 (29.4)	2.9 (1.1)	69.8 (27.5)	79.4 (31.3)

*Data given in centimeters with inches in parentheses.

WAIST FRONT

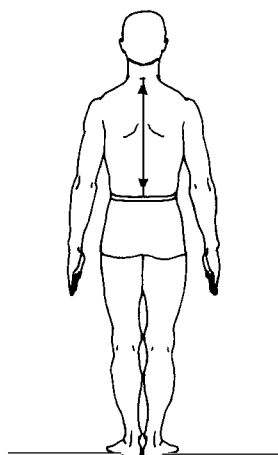


Definition: The surface distance from the suprasternal landmark to the anterior waist landmark. The subject stands erect, looking straight ahead.

Application: Sizing of clothing and personal protective equipment;
Equipment design: length of personal equipment to be worn on the torso such as respirator packs and rigid body armor.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women							
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	40.4 (15.9)	2.2 (0.9)	36.9 (14.5)	44.2 (17.4)
NASA Astronauts	Dates Vary	50	28-43	38.2 (15.0)	2.6 (1.0)	34.4 (13.5)	42.4 (16.7)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	38.9 (15.3)	2.0 (0.8)	35.9 (14.1)	42.5 (16.7)
French Fliers							
German AF	1975	1004	Not Reported	39.0 (15.4)	2.1 (0.8)	35.8 (14.1)	42.7 (16.8)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.



WAIST BACK

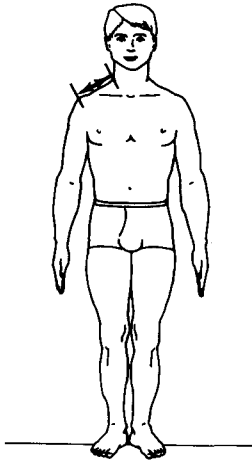
Definition: The surface distance along the spine from the cervicale landmark to the posterior waist landmark. The subject stands erect, with his head in the Frankfort plane.

Application: Sizing of clothing and personal protective equipment;
Equipment design: length of personal equipment to be worn on the torso such as respirator packs and rigid body armor.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	40.5 (15.9)	2.2 (0.9)	37.0 (14.6)	44.3 (17.4)
U.S. HEW Civ.							
British Civ.	1957	4995	18-55+	38.0 (15.0)	2.3 (0.9)	34.2 (13.5)	41.9 (16.5)
Swedish Civ.							
Japanese Civ.	1967-68 1972-73	1622	25-39	37.7 (14.8)	1.7 (0.7)	34.9 (13.7)	40.5 (15.9)
MALES							
USAF Flying Personnel	1967	2420	21-50	46.9 (18.5)	2.4 (0.9)	43.1 (17.0)	50.9 (20.0)
NASA Astro-nauts	Dates Vary	50	28-43	46.6 (18.3)	2.2 (0.9)	43.5 (17.1)	50.5 (19.9)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	45.5 (17.9)	2.2 (0.9)	41.7 (16.4)	49.1 (19.3)
French Fliers							
German AF	1975	1004	Not Reported	45.6 (18.0)	2.6 (1.0)	41.3 (16.3)	50.1 (19.7)
Japanese Civ.	1967-68 1972-73	1870	25-39	46.0 (18.1)	2.5 (1.0)	41.9 (16.5)	50.1 (19.7)

*Data given in centimeters with inches in parentheses.

SHOULDER LENGTH



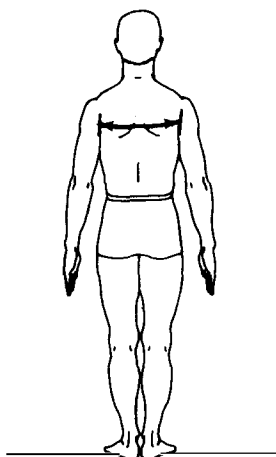
Definition: The surface distance along the top of the shoulder from the right lateral neck landmark to the right acromial landmark. The subject stands erect, looking straight ahead.

Application: Sizing of clothing and body personal protective equipment;
Equipment design: width of webbing and straps of restraint systems and suspension for packs and harnesses.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	14.7 (5.8)	1.0 (0.4)	13.0 (5.1)	16.4 (6.5)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	16.6 (6.5)	1.3 (0.5)	14.6 (5.7)	18.7 (7.4)
NASA Astro-nauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	16.8 (6.6)	1.2 (0.5)	14.9 (5.9)	18.6 (7.3)
French Fliers							
German AF	1975	1004	Not Reported	14.2 (5.6)	1.7 (0.7)	11.2 (4.4)	16.7 (6.6)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

INTERSCYE



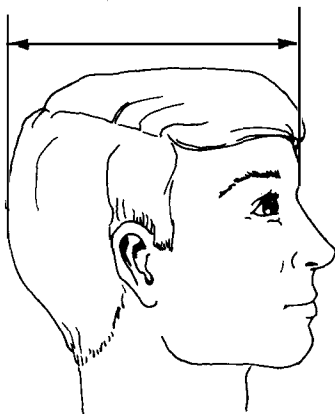
Definition: The horizontal distance across the back between the posterior scye point landmarks. The subject stands erect with the arms relaxed.

Application: Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	35.1 (13.8)	2.4 (0.9)	31.2 (12.3)	39.2 (15.4)
U.S. HEW Civ.							
British Civ.	1957	4994	18-55+	33.9 (13.3)	2.9 (1.1)	29.4 (11.6)	38.9 (15.3)
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	38.8 (15.3)	3.8 (1.5)	32.5 (12.8)	45.0 (17.7)
NASA Astronauts	Dates Vary	52	28-43	36.4 (14.3)	2.3 (0.9)	32.6 (12.8)	40.2 (15.8)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	39.4 (15.5)	2.6 (1.0)	35.3 (13.9)	44.1 (17.4)
French Fliers							
German AF	1975	1004	Not Reported	43.3 (17.0)	3.8 (1.5)	37.1 (14.6)	49.6 (19.5)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

HEAD LENGTH

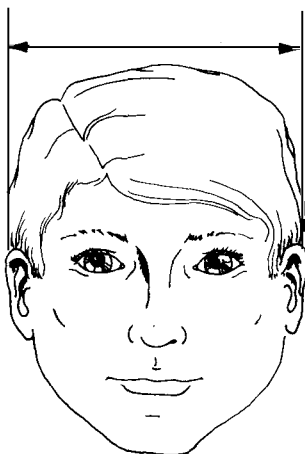


Definition: The maximum length of the head between the glabella and the occiput in the midsagittal plane.

Application: General body description;
Sizing of clothing and personal protective equipment;
Equipment design: protective head gear and equipment suspension systems for head and face.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	18.4 (7.2)	0.7 (0.3)	17.3 (6.8)	19.5 (7.7)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	19.9 (7.8)	0.7 (0.3)	18.8 (7.4)	21.0 (8.3)
NASA Astro- nauts	Dates Vary	28	28-43	20.0 (7.9)	0.5 (0.2)	19.2 (7.6)	20.8 (8.2)
RAF Flying Personnel	1970-71	2000	18-45	19.9 (7.8)	0.6 (0.2)	18.8 (7.4)	20.9 (8.2)
Italian Military	1960	1342	18-59	19.3 (7.6)	0.7 (0.3)	18.2 (7.3)	20.4 (8.0)
French Fliers	1973	65	27-32	19.5 (7.7)	0.6 (0.2)	18.6 (7.2)	20.5 (8.1)
German AF	1975	1004	Not Reported	19.2 (7.6)	0.8 (0.3)	17.7 (7.0)	20.4 (8.0)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.



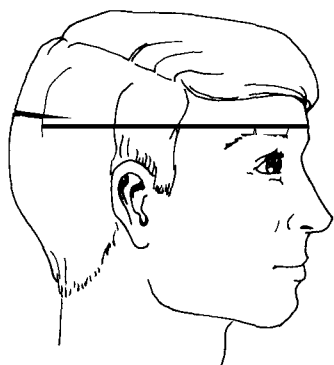
HEAD BREADTH

Definition: The maximum horizontal breadth of the head above the level of the ears.

Application: General body description;
Sizing of clothing and personal protective equipment;
Equipment design: protective head gear and equipment suspension systems for head and face.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	14.5 (5.7)	0.6 (0.2)	13.5 (5.3)	15.5 (6.1)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	15.6 (6.1)	0.5 (0.2)	14.7 (5.8)	16.5 (6.5)
NASA Astronauts	Dates Vary	28	28-43	15.6 (6.1)	0.6 (0.2)	14.6 (5.7)	16.6 (6.5)
RAF Flying Personnel	1970-71	2000	18-45	15.8 (6.2)	0.5 (0.2)	14.9 (5.9)	16.6 (6.5)
Italian Military	1960	1342	18-59	15.5 (6.1)	0.6 (0.2)	14.6 (5.7)	16.5 (6.5)
French Fliers	1973	65	27-32	15.4 (6.1)	0.5 (0.2)	14.6 (5.7)	16.2 (6.4)
German AF	1975	1004	Not Reported	15.7 (6.2)	0.6 (0.2)	14.7 (5.8)	16.7 (6.6)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.



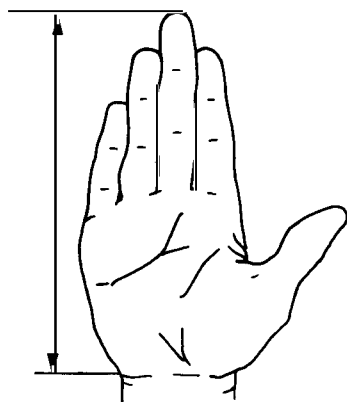
HEAD CIRCUMFERENCE

Definition: The maximum circumference of the head passing above the brow ridges.

Application: General body description;
Sizing of clothing and personal protective equipment;
Equipment design: protective head gear and equipment suspension systems for head and face.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	54.9 (21.6)	1.6 (0.6)	52.3 (20.6)	57.6 (22.7)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.	1967-68 1972-73	1622	25-39	54.5 (21.5)	1.4 (0.6)	52.2 (20.6)	56.8 (22.4)
MALES							
USAF Flying Personnel	1967	2420	21-50	57.5 (22.6)	1.4 (0.6)	55.2 (21.7)	59.9 (23.6)
NASA Astronauts	Dates Vary	57	28-43	57.6 (22.7)	1.3 (0.5)	55.3 (21.8)	59.7 (23.5)
RAF Flying Personnel	1970-71	2000	18-45	57.7 (22.7)	1.4 (0.6)	55.5 (21.9)	59.9 (23.6)
Italian Military	1960	1342	18-59	56.5 (22.2)	1.4 (0.6)	54.2 (21.3)	58.8 (23.1)
French Fliers	1973	65	27-32	56.8 (22.4)	1.5 (0.6)	54.5 (21.5)	59.2 (23.3)
German AF	1975	1004	Not Reported	57.0 (22.4)	1.4 (0.6)	54.7 (21.5)	59.5 (23.4)
Japanese Civ.	1967-68 1972-73	1870	25-39	56.5 (22.2)	1.5 (0.6)	54.0 (21.3)	59.0 (23.2)

*Data given in centimeters with inches in parentheses.



HAND LENGTH

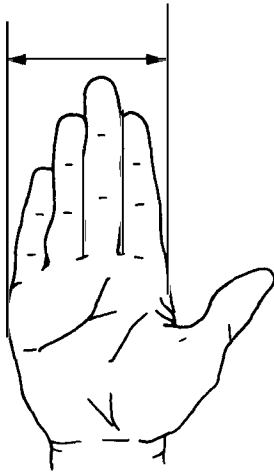
Definition: The distance from the wrist landmark to dactylion. The subject sits with the hand flat on a table, palm up, with fingers together and straight.

Application: General body description;
Sizing of clothing and personal protective equipment;
Body linkage and models.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	18.4 (7.2)	1.0 (0.4)	16.9 (6.7)	20.1 (7.9)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.	1968	162	20-49	17.9 (7.0)	1.0 (0.4)	16.3 (6.4)	19.6 (7.7)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	19.1 (7.5)	0.8 (0.3)	17.8 (7.0)	20.5 (8.1)
NASA Astro-nauts	Dates Vary	25	28-43	19.0 (7.5)	1.3 (0.5)	16.9 (6.7)	21.1 (8.3)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	19.0 (7.5)	0.9 (0.4)	17.6 (6.9)	20.4 (8.0)
French Fliers	1973	65	27-32	19.2 (7.6)	0.8 (0.3)	17.7 (7.0)	20.4 (8.0)
German AF	1975	1004	Not Reported	18.9 (7.4)	0.9 (0.4)	17.4 (6.9)	20.3 (8.0)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

HAND BREADTH



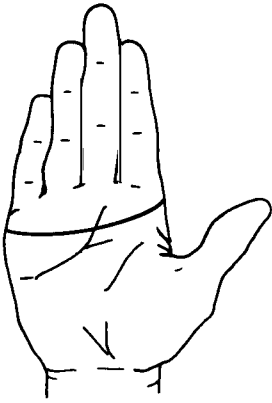
Definition: The breadth of the hand between meta-carpal-phalangeal joints II and V. The subject sits with the hand flat on a table, palm down, with the fingers together and straight.

Application: General body description;
Sizing of clothing and body personal protective equipment;
Equipment design: width of grasping surface for controls, handholds, and handles.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	7.6 (3.0)	0.4 (0.2)	6.9 (2.7)	8.2 (3.2)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.	1968	214	20-49	7.7 (3.0)	0.4 (0.2)	7.1 (2.8)	8.3 (3.3)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	8.9 (3.5)	0.4 (0.2)	8.2 (3.2)	9.6 (3.8)
NASA Astronauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	8.9 (3.5)	0.4 (0.2)	8.2 (3.2)	9.6 (3.8)
French Fliers	1973	65	27-32	8.7 (3.4)	0.4 (0.2)	8.1 (3.2)	9.4 (3.7)
German AF	1975	1004	Not Reported	8.6 (3.4)	0.4 (0.2)	7.9 (3.1)	9.3 (3.7)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

HAND CIRCUMFERENCE

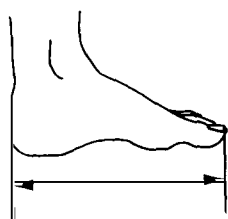


Definition: The circumference of the hand passing over the metacarpal-phalangeal joints II and V. The subject sits with the hand flat on a table, palm down, fingers extended, and thumb abducted.

Application: General body description;
Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	18.3 (7.2)	0.9 (0.4)	16.8 (6.6)	19.8 (7.8)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	21.6 (8.5)	0.9 (0.4)	20.0 (7.9)	23.1 (9.1)
NASA Astronauts	Dates Vary	33	28-43	21.2 (8.3)	3.0 (1.2)	16.2 (6.4)	26.2 (10.3)
RAF Flying Personnel							
Italian Military	1960	1342	18-59	21.6 (8.5)	1.0 (0.4)	20.0 (7.9)	23.2 (9.1)
French Fliers	1973	65	27-32	21.7 (8.5)	1.0 (0.4)	20.2 (8.0)	23.4 (9.2)
German AF	1975	1004	Not Reported	21.3 (8.4)	1.3 (0.5)	19.1 (7.5)	23.5 (9.3)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.



FOOT LENGTH

Definition: The distance, parallel to the long axis of the foot, from the back of the heel to the tip of the most protruding toe. The subject stands with weight equally distributed on both feet.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout;
Body linkage and models.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	24.1 (9.5)	1.1 (0.4)	22.2 (8.7)	26.0 (10.2)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.	1968	210	20-49	24.6 (9.7)	1.1 (0.4)	22.8 (9.0)	26.3 (10.4)
Japanese Civ.	1967-68 1972-73	1622	25-39	22.6 (8.9)	0.9 (0.4)	21.1 (8.3)	24.1 (9.5)
MALES							
USAF Flying Personnel	1967	2420	21-50	27.0 (10.6)	1.2 (0.5)	25.1 (9.9)	29.1 (11.5)
NASA Astro- nauts							
RAF Flying Personnel	1970-71	2000	18-45	26.6 (10.5)	1.2 (0.5)	24.7 (9.7)	28.6 (11.3)
Italian Military	1960	1342	18-59	26.5 (10.4)	1.1 (0.4)	24.6 (9.7)	28.4 (11.2)
French Fliers	1973	65	27-32	26.5 (10.4)	1.1 (0.4)	24.7 (9.7)	28.5 (11.2)
German AF	1975	1004	Not Reported	26.4 (10.4)	1.2 (0.5)	24.5 (9.6)	28.5 (11.2)
Japanese Civ.	1967-68 1972-73	1870	25-39	24.4 (9.6)	1.0 (0.4)	22.8 (9.0)	26.0 (10.2)

*Data given in centimeters with inches in parentheses.



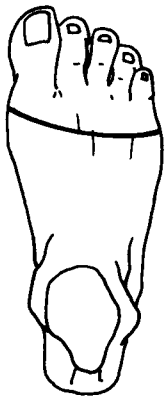
FOOT BREADTH

Definition: The maximum horizontal distance across the foot, at right angles to the long axis. The subject stands with weight equally distributed on both feet.

Application: General body description;
Sizing of clothing and personal protective equipment;
Workspace layout.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	8.9 (3.5)	0.5 (0.2)	8.0 (3.1)	9.8 (3.9)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.	1968	210	20-49	9.5 (3.7)	0.7 (0.3)	8.4 (3.3)	10.5 (4.1)
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	9.8 (3.9)	0.5 (0.2)	9.0 (3.5)	10.6 (4.2)
NASA Astro-nauts	Dates Vary	27	28-43	10.3 (4.1)	0.5 (0.2)	9.5 (3.7)	11.1 (4.4)
RAF Flying Personnel	1970-71	1998	18-45	9.5 (3.7)	0.4 (0.2)	8.8 (3.5)	10.3 (4.1)
Italian Military	1960	1342	18-59	10.2 (4.0)	0.5 (0.2)	9.4 (3.7)	11.0 (4.3)
French Fliers	1973	65	27-32	10.3 (4.1)	0.5 (0.2)	9.5 (3.7)	11.3 (4.4)
German AF	1975	1004	Not Reported	10.1 (4.0)	0.6 (0.2)	9.2 (3.6)	11.0 (4.3)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.



BALL OF FOOT CIRCUMFERENCE

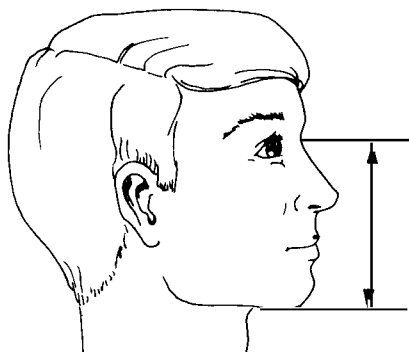
Definition: The circumference of the foot over the distal ends of the metatarsal bones. The subject stands with his feet slightly apart and weight distributed equally on both feet.

Application: General body description;
Sizing of clothing and personal protective equipment.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women							
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	24.8 (9.8)	1.2 (0.5)	22.9 (9.0)	27.0 (10.6)
NASA Astronauts							
RAF Flying Personnel	1970-71	2000	18-45	25.0 (9.8)	1.2 (0.5)	23.1 (9.1)	27.0 (10.6)
Italian Military	1960	1342	18-59	25.2 (9.9)	1.2 (0.5)	23.2 (9.1)	27.1 (10.7)
French Fliers	1973	65	27-32	25.2 (9.9)	1.2 (0.5)	23.0 (9.1)	27.0 (10.6)
German AF	1975	1004	Not Reported	25.0 (9.8)	1.3 (0.5)	22.9 (9.0)	27.2 (10.7)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

MENTON-SELLION (FACE) LENGTH



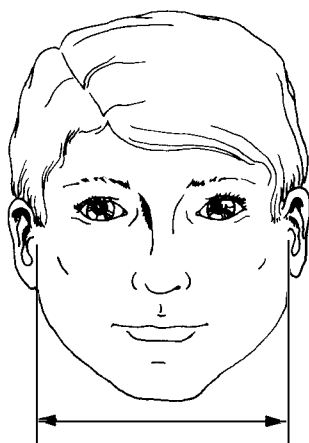
Definition: The distance from the menton landmark to the deepest point of the nasal root depression. The subject sits with mouth closed and jaw relaxed.

Application: General body description; Sizing of clothing and personal protective equipment; Equipment design: length of oral-nasal oxygen mask and respirator face pieces.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	10.6 (4.2)	0.6 (0.2)	9.6 (3.8)	11.7 (4.6)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	12.0 (4.7)	0.6 (0.2)	11.0 (4.3)	13.0 (5.1)
NASA Astronauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	11.9 (4.7)	0.6 (0.2)	11.0 (4.3)	12.9 (5.1)
French Fliers	1973	65	27-32	12.7 (5.0)	0.6 (0.2)	11.8 (4.6)	13.7 (5.)
German AF	1975	1004	Not Reported	12.0 (4.7)	0.7 (0.3)	10.9 (4.3)	13.2 (5.2)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

BIZYGOMATIC (FACE) BREADTH



Definition: The maximum horizontal breadth of the face between the zygomatic arches.

Application: General body description;
Sizing of clothing and personal protective equipment;
Equipment design: respirator face pieces and face shields.

Sample & Reference	Survey Date	No. of Subj.	Age Range	Descriptive Statistics*			
				$\bar{X}$	SD	5%ile	95%ile
FEMALES							
USAF Women	1968	1905	18-56	12.9 (5.1)	0.6 (0.2)	11.9 (4.7)	13.8 (5.4)
U.S. HEW Civ.							
British Civ.							
Swedish Civ.							
Japanese Civ.							
MALES							
USAF Flying Personnel	1967	2420	21-50	14.2 (5.6)	0.5 (0.2)	13.4 (5.3)	15.1 (5.9)
NASA Astro-nauts							
RAF Flying Personnel							
Italian Military	1960	1342	18-59	14.3 (5.6)	0.5 (0.2)	13.5 (5.3)	15.2 (6.0)
French Fliers	1973	65	27-32	14.2 (5.6)	0.5 (0.2)	13.5 (5.3)	14.8 (5.8)
German AF	1975	1004	Not Reported	13.3 (5.2)	0.8 (0.3)	11.9 (4.7)	14.7 (5.8)
Japanese Civ.							

*Data given in centimeters with inches in parentheses.

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APPENDIX A

A GLOSSARY OF ANATOMICAL AND ANTHROPOMETRIC TERMS

A

abdominal extension level -- the most anterior point on the curve of the abdomen in the midsagittal plane.

abduct -- to move away from the axis of the body or one of its parts.

acromion -- the most lateral point of the lateral edge of the spine of the scapula. Acromial height is usually equated with shoulder height.

anterior -- pertaining to the front of the body; as opposed to posterior.

auricular -- pertaining to the external ear.

axilla -- the armpit.

B

bi -- a prefix denoting connection with or relation to each of two symmetrically paired parts.

biceps brachii -- the large muscle on the anterior surface of the upper arm.

biceps femoris -- a large posterior muscle of the thigh.

brow ridges -- the bony ridges of the forehead that lie above the orbits of the eye.

bustpoint -- the most anterior protrusion of the right bra pocket.

buttock protrusion -- the maximum posterior protrusion of the right buttock.

C

calcaneus -- the heel bone.

canthus -- a corner or angle formed by the meeting of the eyelids.

carpus -- the wristbones, collectively.

cervicale -- the protrusion of the spinal column at the base of the neck caused by the tip of the spine (q.v.) of the 7th cervical vertebra.

cheilion -- the corners of the mouth formed by the juncture of the lips.
coronal plane -- any vertical plane at right angles to the midsagittal plane.
crinion -- the point in the midplane where the hairline meets the forehead.
cutaneous lip -- the area between the upper lip and the nose.

D

dactylion -- the tip of the middle finger.
deltoid muscle -- the large muscle on the lateral border of the upper arm in the shoulder region.
distal -- the end of a body segment farthest from the head, as opposed to proximal.

E

ectocanthus (also external canthus) -- the outside corner or angle formed by the meeting of the eyelids.
endocanthus -- the inside corner or angle formed by the meeting of the eyelids.
epicondyle -- the bony eminence at the distal end of the humerus, radius, and femur.
extend -- to move adjacent segments so that the angle between them is increased, as when the leg is straightened; as opposed to flex.
external -- away from the central long axis of the body; the outer portion of a body segment.

F

femoral epicondyles -- the bony projections on either side of the distal end of the femur.
femur -- the thigh bone.
flex -- to move a joint in such a direction as to bring together the two parts which it connects, as when the elbow is bent; as opposed to extend.
fossa -- a depression, usually somewhat longitudinal in shape, in the surface of a part, as in a bone.

Frankfort plane -- the standard horizontal plane or orientation of the head.
The plane is established by a line passing through the right tragion (approximate earhole) and the lowest point of the right orbit (eye socket).

G

gastrocnemius -- the largest muscle in the calf of the leg.

glabella -- the most anterior point of the forehead between the brow ridges in the midsagittal plane.

gluteal furrow -- the furrow at the juncture of the buttock and the thigh.

gonial angle -- the angle at the back of the lower jaw formed by the intersection of the vertical and horizontal portions of the jaw.

H

helix -- the rolled outer part of the ear.

humerus -- the bone of the upper arm.

humeral epicondyles -- the bony projections on either side of the distal end of the humerus.

hyperextend -- to overextend a limb or other part of the body.

I

iliac crest -- the superior rim of the pelvic bone.

inferior -- below, in relation to another structure; lower.

inion -- the summit of the external occipital protuberance; the most posterior bony protuberance on the back of the head.

inseam -- a term used in tailoring to indicate the inside length of a sleeve or trouser leg. It is measured on the medial side of the arm or leg.

internal -- near the central long axis of the body; the inner portion of a body segment.

interpupillary -- between the centers of the pupils of the eyes.

J-K

knuckle -- the joint formed by the meeting of a finger bone (phalanx) with a palm bone (metacarpal).

L

lateral -- lying near or toward the sides of the body; as opposed to medial.

lateral malleolus -- the lateral bony protrusion of the ankle.

larynx -- the cartilaginous box of the throat that houses the voice mechanism. The "Adam's apple" is the most noticeable part of the larynx.

lip prominence -- the most anterior protrusion of either the upper or the lower lip.

M

malleolus -- a rounded bony projection in the ankle region. There is one on both the lateral and the medial side of the leg.

mandible -- the lower jaw.

mastoid process -- a bony projection on the inferior lateral surface of the temporal bone behind the ear.

medial -- lying near or toward the midline of the body; as opposed to lateral.

menton -- the point of the tip of the chin in the midsagittal plane.

metacarpal -- pertaining to the long bones of the hand between the carpus and the phalanges.

midaxillary line -- a vertical line passing through the center of the axilla.

midpatella -- a point one-half the distance between the superior and the inferior margins of the right patella.

midsagittal plane -- the vertical plane which divides the body into right and left halves.

midshoulder -- a point one-half the distance between the neck and the right acromion.

N

nasal root depression -- the area of greatest indentation where the bridge of the nose meets the forehead.

nasal septum -- the cartilaginous wall separating the right nostril from the left.

navicular bone -- the small bone of the hand just distal to the bend of the wrist on the thumb side.

nuchale -- the lowest point in the midsagittal plane of the occiput that can be palpated among the muscles in the posterior-superior part of the neck. This point is often visually obscured by hair.

O

ocular -- pertaining to the eye.

occipital bone -- a curved bone forming the back and part of the base of the skull.

olecranon -- the proximal end of the ulna (the medial forearm bone).

omphalion -- the center point of the navel.

orbit -- the eye socket.

P

patella -- the kneecap.

phalanges -- the bones of the fingers and toes (singular, phalanx).

philtrum -- the vertical groove that runs from the upper lip to the base of the nasal septum.

plantar -- pertaining to the sole of the foot.

popliteal -- pertaining to the ligament behind the knee or to the part of the leg back of the knee.

posterior -- pertaining to the back of the body; as opposed to anterior.

pronasale -- the most anterior point on the nose.

proximal -- the end of a body segment nearest the head; as opposed to distal.

Q-R

radiale -- the uppermost point on the lateral margin of the proximal end of the radius.

radius -- the bone of the forearm on the thumb side of the arm.

ramus -- the vertical portion of the lower jaw bone (mandible).

S

sagittal -- pertaining to the anteroposterior median plane of the body, or to a plane parallel to the median.

scapula -- the shoulder blade.

scye -- a tailoring term to designate the armhole of a garment. Refers here to landmarks which approximate the lower level of the axilla.

sellion -- the point of greatest indentation of the nasal root depression.

septum -- a dividing wall between two cavities; the nasal septum is the fleshy partition between the two nasal cavities.

sphyrion -- the most distal extension of the tibia on the medial side of the foot.

spine (or spinal process) of vertebrae -- the posterior prominences of the vertebrae.

sternum -- the breastbone.

stomion -- the point of contact in the midsagittal plane between the upper and lower lip.

stylium -- the most distal point on the styloid process of the radius.

styloid process -- a long, spinelike projection of a bone.

sub -- a prefix designating below or under.

submandibular -- below the mandible or lower jaw.

subnasale -- the point where the base of the nasal septum meets the philtrum.

substernale -- the point located at the middle of the lower edge of the breastbone.

superior -- above, in relation to another structure; higher.

supra -- prefix designating above or on.

suprasternale -- the lowest point in the notch in the upper edge of the breastbone.

surface distance -- a measurement that follows the general contours of the surface of the body.

T

tarsus -- the collection of bones in the ankle joint, at the distal end of the tibia.

temporal crest -- a narrow bony ridge along the side of the head above the ear level that serves as a point of attachment for the temporal muscles.

temporal muscles -- the muscles of the temple region.

thyroid cartilage -- the bulge of the cartilage on the anterior surface of the throat; in men, the Adam's apple.

tibia -- the medial bone of the leg (shin bone).

tibiale -- the uppermost point of the medial margin of the tibia.

tragion -- the point located at the notch just above the tragus of the ear.

trapezius muscle -- the large muscle on each side of the back of the neck and shoulders, the action of which moves the shoulders.

triceps -- the muscle mass of the posterior upper arm.

trochanterion -- the tip of the bony lateral protrusion of the proximal end of the femur.

U

ulna -- one of the bones of the forearm on the little finger side of the arm.

V

vertex -- the top of the head.

W-X-Y-Z

zygomatic arch -- the bony arch below the orbit of the skull extending horizontally along the side of the head from the cheekbone (the zygomatic bone) nearly to the external ear.

ILLUSTRATED GLOSSARY

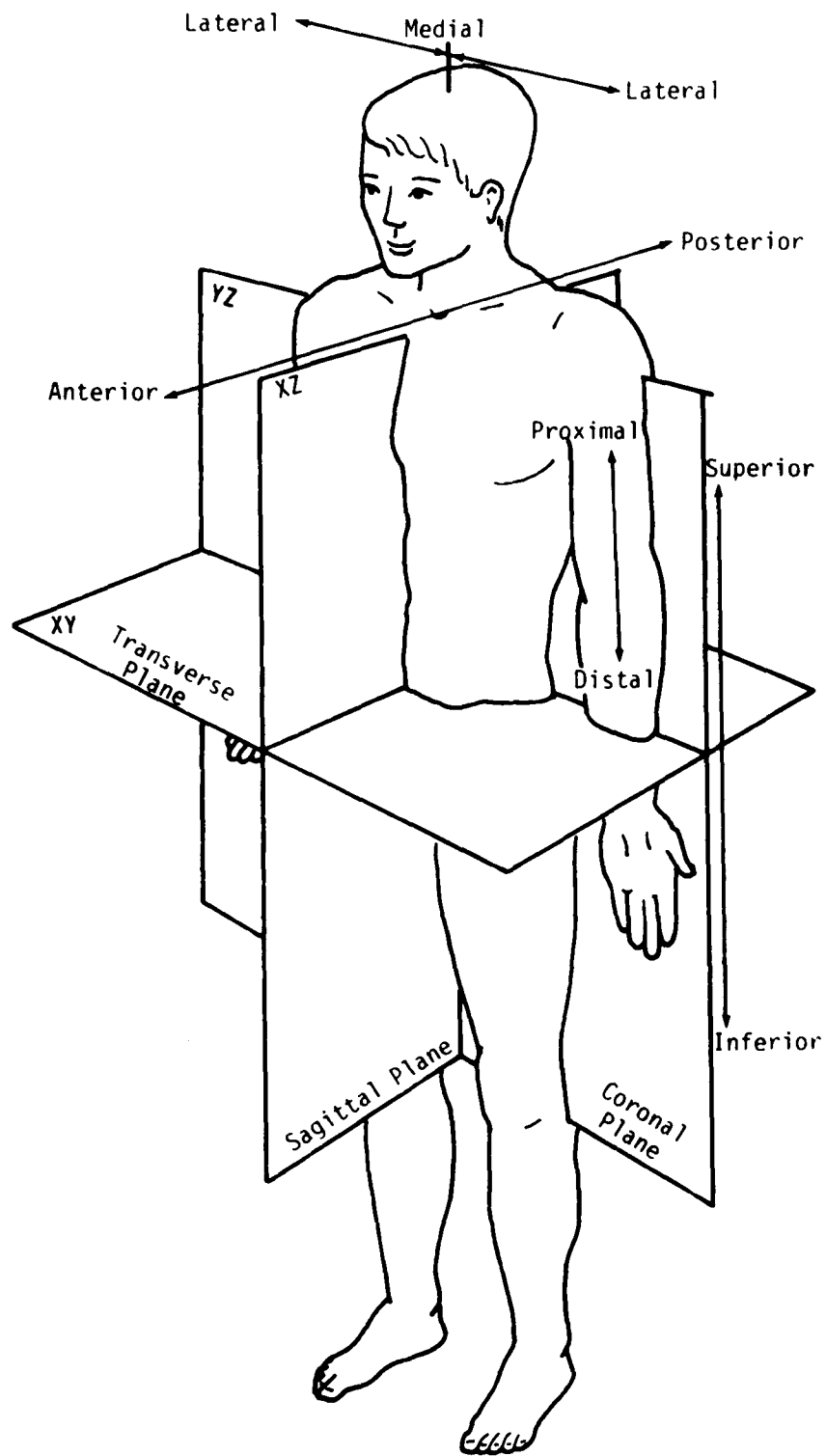


Figure 1. Anatomical planes and orientations.

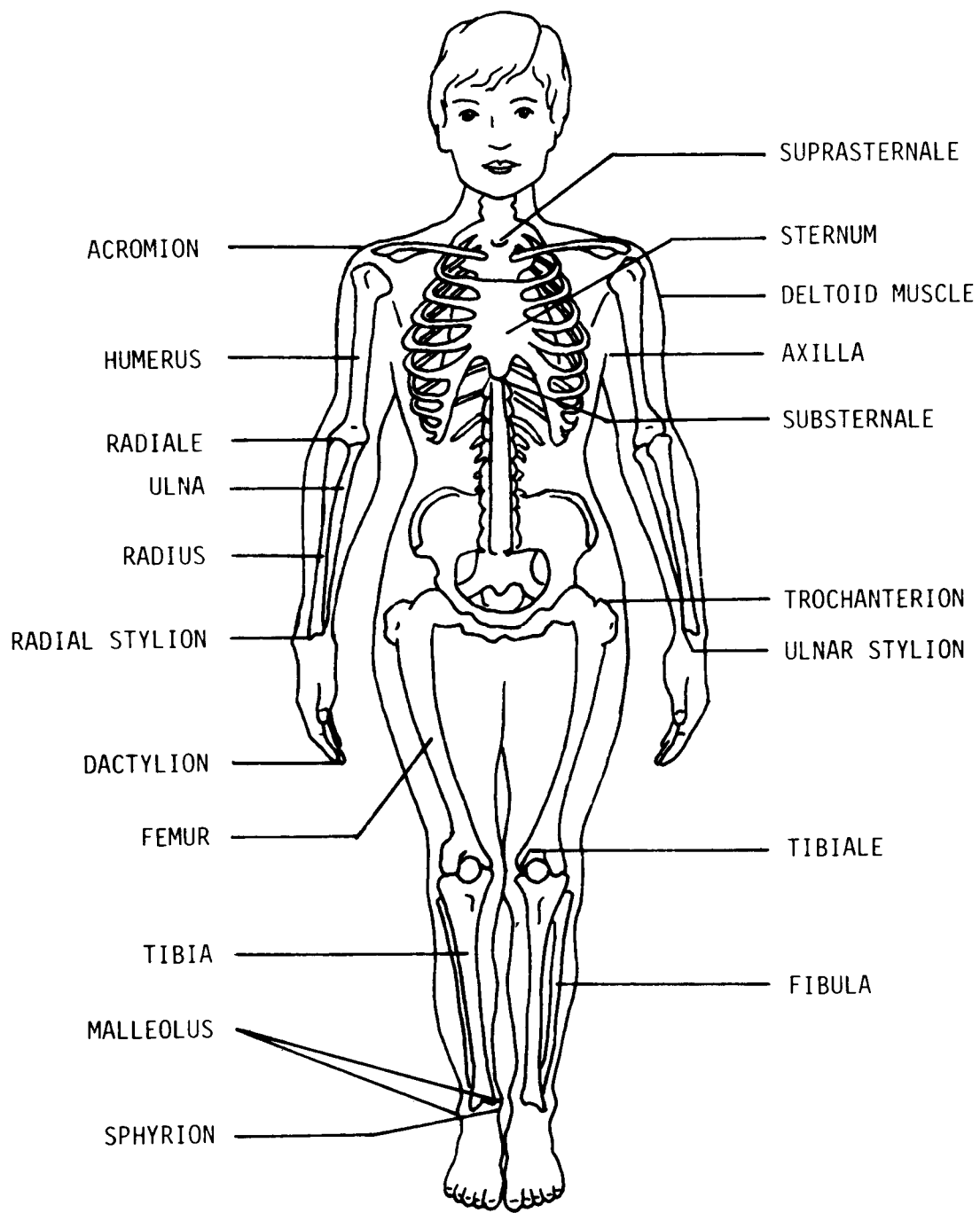


Figure 2. Anatomical and anthropometric landmarks.

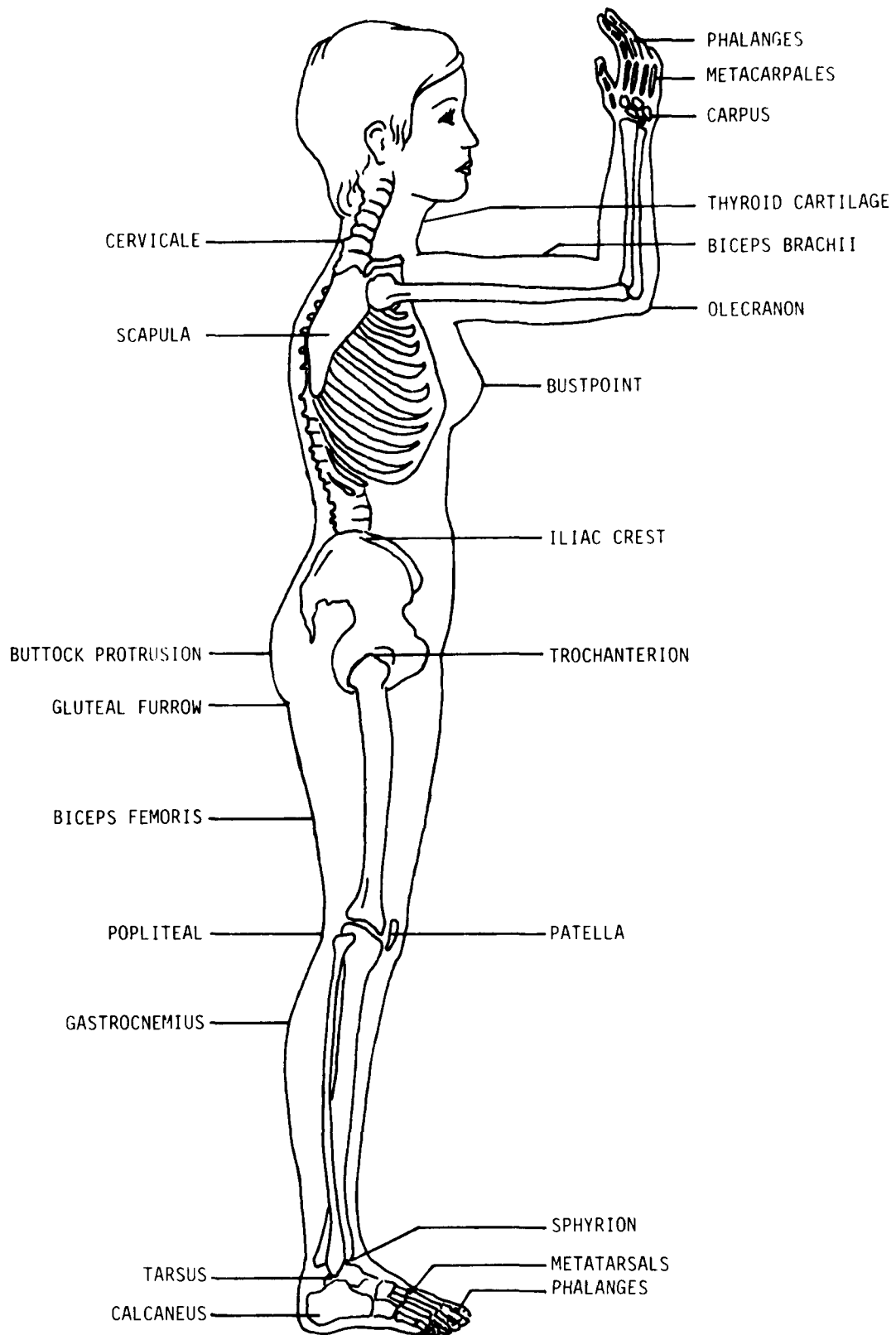


Figure 3. Anatomical and anthropometric landmarks.

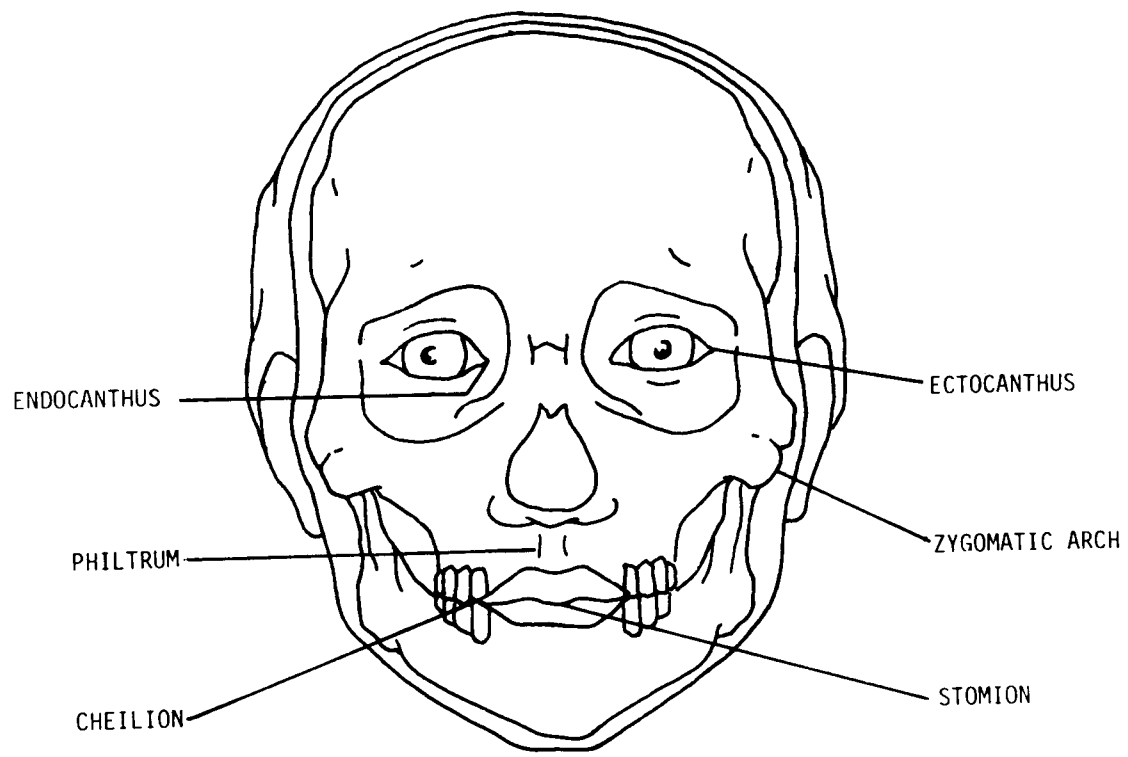


Figure 4. Anthropometric landmarks of the head and face.

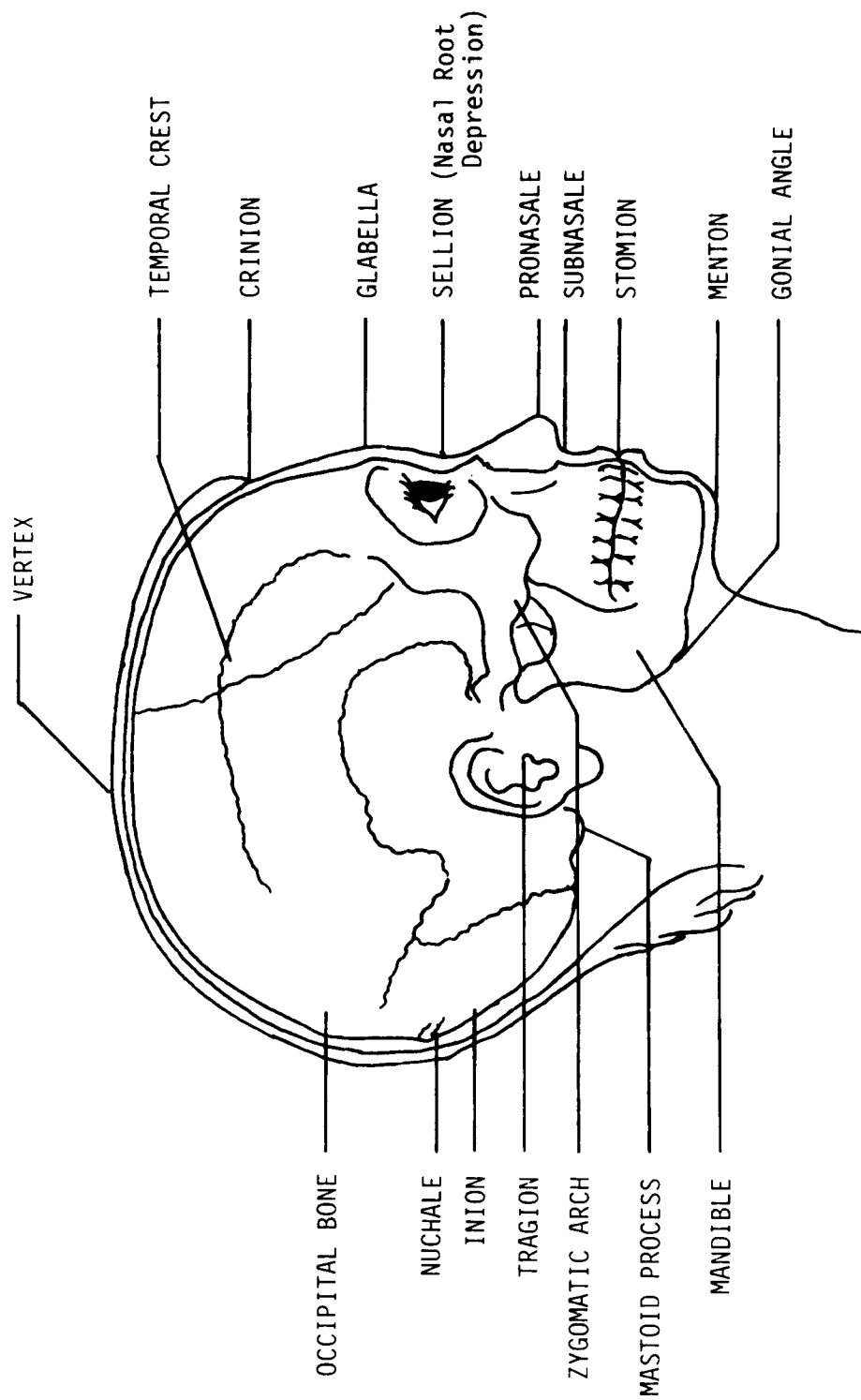


Figure 5. Anthropometric landmarks of the head and face.

APPENDIX B

PROJECTED 1985 BODY SIZE DATA

PROJECTED 1985 BODY SIZE DATA

As man/machine systems become increasingly more complex, the research and development cycle from concept to ultimate end product is continually lengthened. The more complex the system, the more time is involved in the establishment of system requirements and design parameters, mock up, prototype fabrication, testing and evaluation prior to the production of the system. This research and development cycle can become so lengthy that the anticipated users of a particular system such as a fighter aircraft, for example, may still be adolescents at the time the basic system requirements are being established. The designer must therefore think in terms of the requirements of users projected five to 15 years in the future.

In Chapter II, sources of human body size variability are described and quantified. There, particular attention was paid to secular changes in the body size of populations over time. To relieve the NASA design engineer of the burden of extrapolating data to the 1980-1990 time frame, the following anthropometric data have been developed for selected body dimensions projected to 1985. The dimensions chosen for inclusion here are the same 59 variables charted in the main body of this chapter and were selected for their general all-around usefulness to NASA engineers.

The male extrapolations were made on the basis of data from a number of surveys of USAF and U.S. Navy flying personnel conducted between 1950 and 1973. The data used were restricted to those from commissioned officers in the 23-35 year age range. Estimates were made for stature and for weight for astronauts aged 35 in 1985; estimates for other bodily dimensions were then computed by modifying the USAF '67 flying personnel data to reflect the anticipated increases in stature and weight.

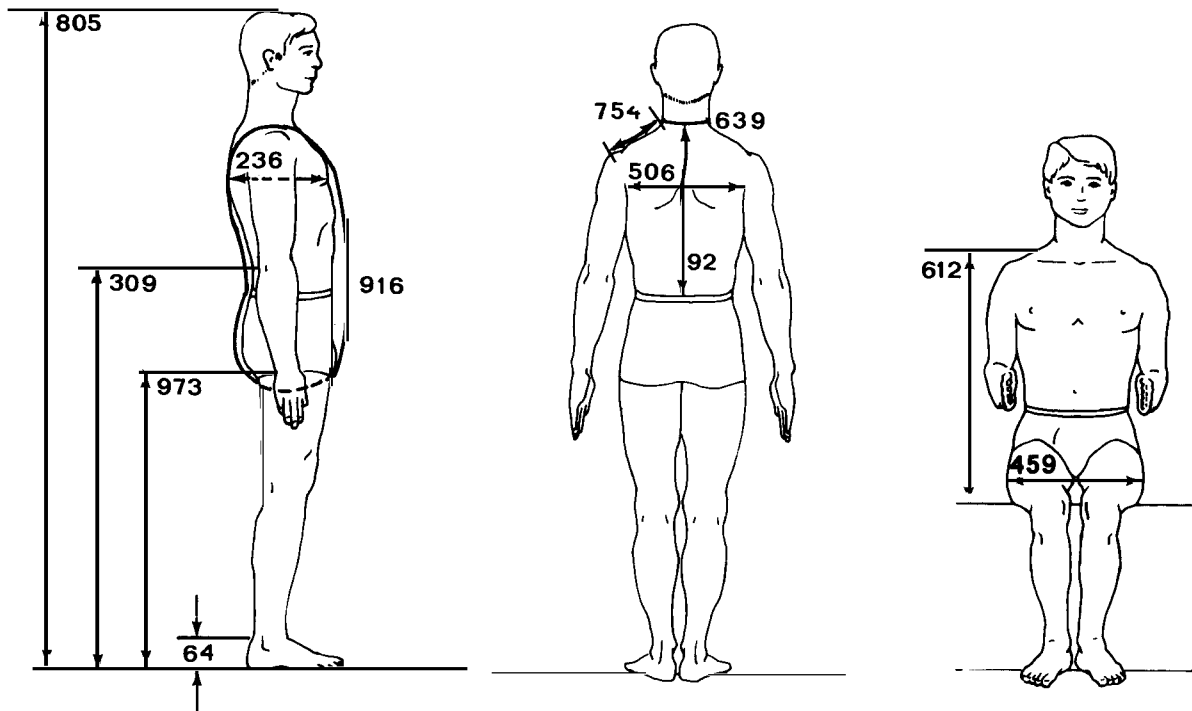
Stature was assumed to be solely dependent on year of birth and statistics for stature were computed, year by year, for men born in each year from 1915 to 1950. Regression lines fitted to the means, 5th percentiles and 95th percentiles of these data suggested a continuing increase in all three statistics of about 8 mm (1/3 inch) per decade. Since the men who will be 35 years old in 1985 were born in 1950, 12-13 years later than the average member of the '67 flying personnel survey, an increase of about one centimeter (0.4 inch) was postulated.

Weight was considered as being primarily related to age and, for purposes of projection, it was assumed that the ponderal index (stature divided by the cube root of weight) was independent of birth year but was a linear function of age. On this basis, a value for the ponderal index for men of 35 was derived. The projected weight was then established by determining the weight which, with the anticipated 1985 stature, corresponded to this

index. Unlike the values of stature, the projected increases in weight increased substantially from the low end to the high end of the body size distribution: 5th %ile, 1.6 kg (3.5 lb); 10th %ile, 1.7 kg (3.7 lb); mean, 1.9 kg (4.2 lb); 90th %ile, 2.1 kg (4.6 lb); 95th %ile, 2.2 kg (4.9 lb).

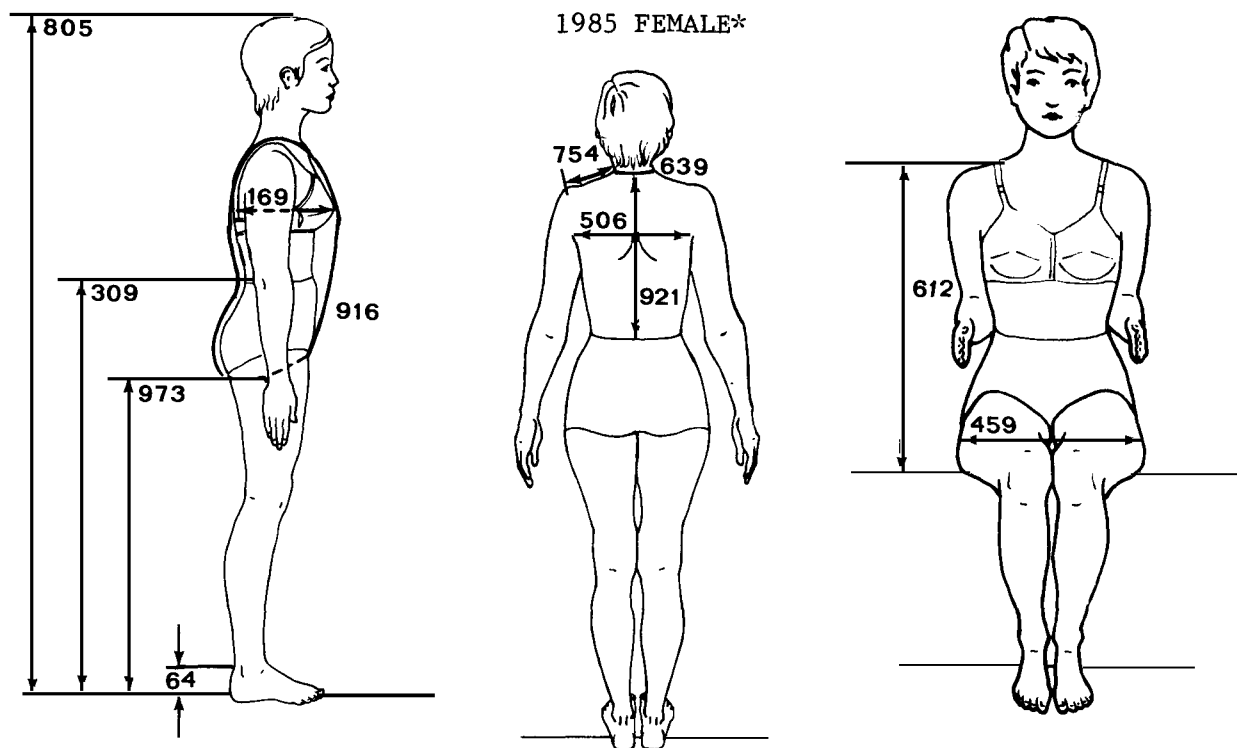
Because no correspondingly large group of surveys on which to study secular changes in the dimensions of female officers exists and because of the small size of the changes in the men's values, the data for the officers' subseries measured in the 1968 Air Force Women's survey have been accepted as the most satisfactory basis from which estimates were made.

1985 MALE*



No.	Dimension	5%ile	Mean	95%ile
805	Stature	168.2 (66.2)	178.4 (70.2)	188.6 (74.3)
973	Wrist height	80.7 (31.8)	87.1 (34.3)	93.9 (37.0)
64	Ankle height	12.1 (4.8)	13.8 (5.4)	15.8 (6.2)
309	Elbow height	105.5 (41.5)	113.0 (44.5)	120.9 (47.6)
236	Chest depth	21.5 (8.5)	24.6 (9.7)	27.8 (10.9)
916	Vertical trunk circumference	157.4 (62.0)	169.0 (66.5)	180.9 (71.2)
612	Midshoulder height, sitting	60.6 (23.9)	65.0 (25.6)	69.6 (27.4)
459	Hip breadth, sitting	34.4 (13.5)	38.1 (15.0)	42.2 (16.6)
921	Waist back	43.3 (17.0)	47.2 (18.6)	51.1 (20.1)
506	Interscye	32.6 (12.8)	38.9 (15.3)	45.2 (17.8)
639	Neck circumference	35.5 (14.0)	38.5 (15.2)	41.8 (16.5)
754	Shoulder length	14.7 (5.8)	16.7 (6.6)	18.9 (7.4)

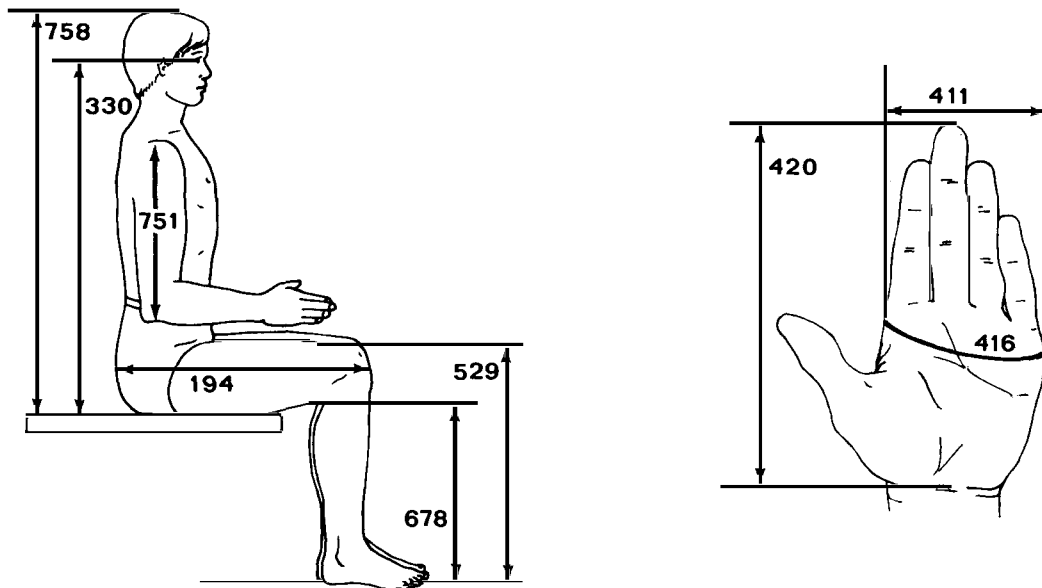
*Data given in centimeters with inches in parentheses.



No.	Dimension	5%ile	Mean	95%ile
805	Stature	152.3 (60.0)	162.8 (64.1)	172.8 (68.0)
973	Wrist height**	73.5 (28.9)	79.4 (31.3)	85.3 (33.6)
64	Ankle height	9.1 (3.6)	11.2 (4.4)	13.6 (5.4)
309	Elbow height**	96.5 (38.0)	102.6 (40.4)	108.7 (42.8)
169	Bust depth	21.1 (8.3)	24.2 (9.5)	28.2 (11.1)
916	Vertical trunk circumference	145.3 (57.2)	156.6 (61.7)	169.0 (66.5)
612	Midshoulder height, sitting	54.2 (21.3)	58.5 (23.0)	63.1 (24.8)
459	Hip breadth, sitting	35.4 (13.9)	38.5 (15.2)	41.6 (16.4)
921	Waist back	36.8 (14.5)	40.5 (15.9)	44.5 (17.5)
506	Interscye	31.4 (12.4)	35.6 (14.0)	39.9 (15.7)
639	Neck circumference	31.3 (12.3)	34.0 (13.4)	37.3 (14.7)
754	Shoulder length	13.1 (5.2)	14.7 (5.8)	16.5 (6.5)

*Data given in centimeters with inches in parentheses.

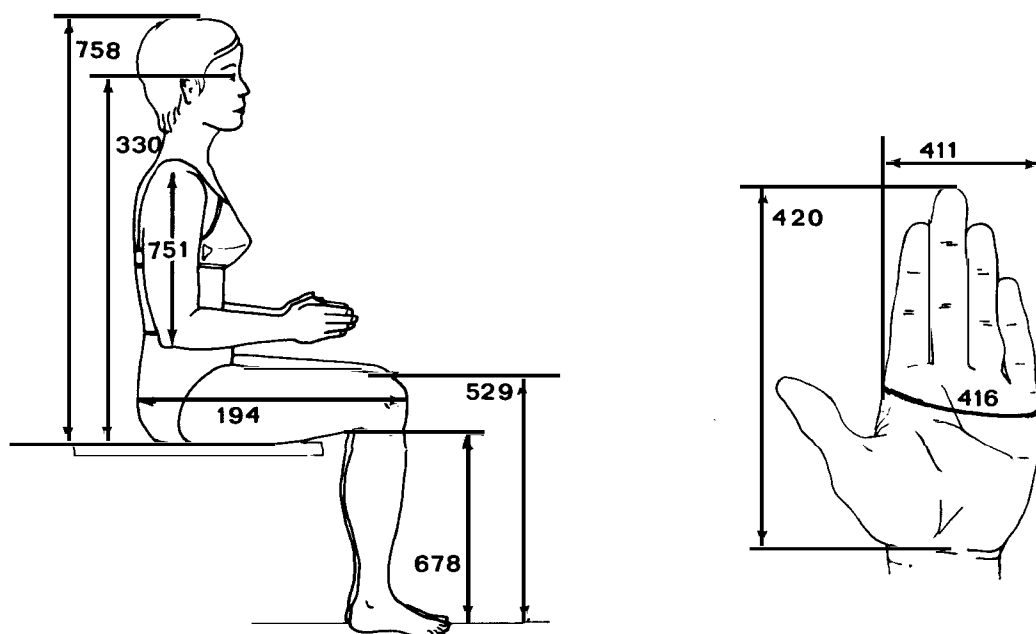
**Estimated from regression equations.



No.	Dimension	5%ile	Mean	95%ile
758	Sitting height	88.5 (34.8)	93.6 (36.9)	99.0 (39.0)
330	Eye height, sitting	76.4 (30.1)	81.3 (32.0)	86.5 (34.1)
529	Knee height, sitting	52.1 (20.5)	56.1 (22.1)	60.3 (23.7)
678	Popliteal height	40.4 (15.9)	44.0 (17.3)	47.8 (18.8)
751	Shoulder-elbow length	33.3 (13.1)	36.1 (14.2)	38.9 (15.3)
194	Buttock-knee length	56.4 (22.2)	60.8 (23.9)	65.4 (25.7)
420	Hand length	17.9 (7.0)	19.2 (7.6)	20.6 (8.1)
411	Hand breadth	8.3 (3.3)	8.9 (3.5)	9.6 (3.8)
416	Hand circumference	20.1 (7.9)	21.6 (8.5)	23.2 (9.1)

*Data given in centimeters with inches in parentheses.

1985 FEMALE*

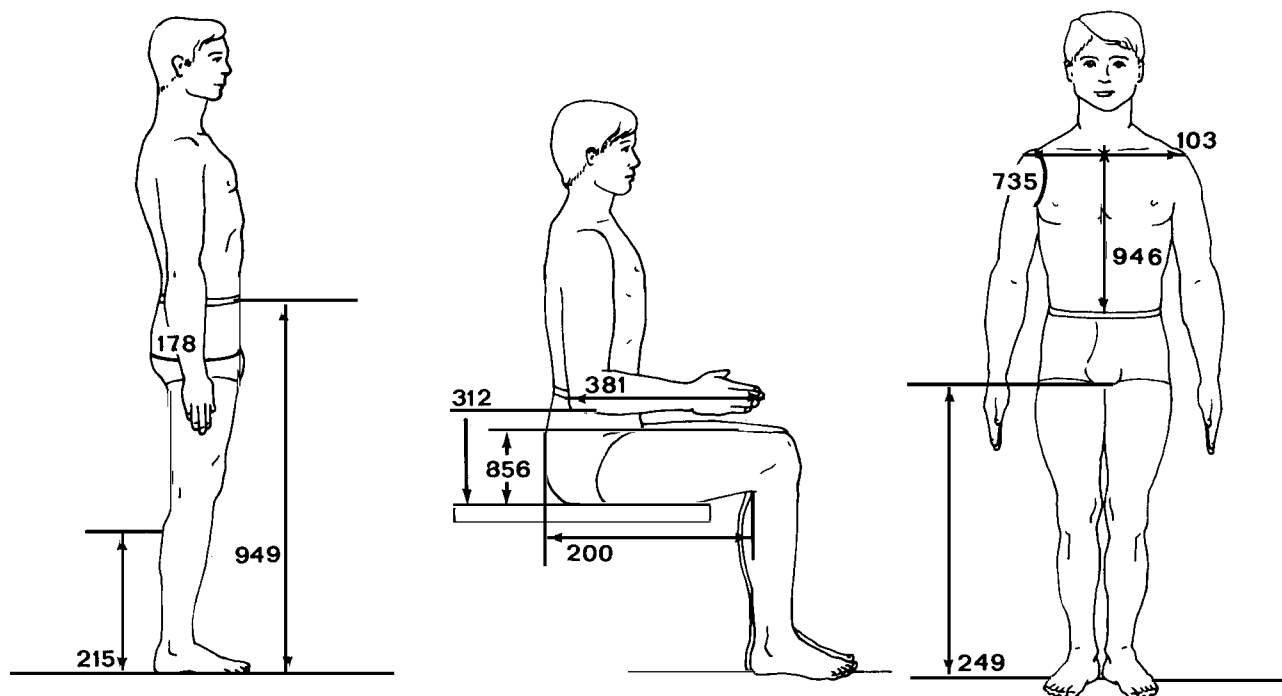


No.	Dimension	5%ile	Mean	95%ile
758	Sitting height	81.2 (32.0)	86.2 (33.9)	91.5 (36.0)
330	Eye height, sitting	69.5 (27.4)	74.4 (29.3)	79.6 (31.3)
529	Knee height, sitting**	46.7 (18.4)	50.5 (19.9)	54.3 (21.4)
678	Popliteal height	37.8 (14.9)	41.0 (16.1)	44.2 (17.4)
751	Shoulder-elbow length**	30.6 (12.0)	33.2 (13.1)	35.8 (14.1)
194	Buttock-knee length	53.3 (21.0)	57.6 (22.7)	62.0 (24.4)
420	Hand length	17.0 (6.7)	18.4 (7.2)	20.1 (7.9)
411	Hand breadth	6.9 (2.7)	7.6 (3.0)	8.3 (3.3)
416	Hand circumference	16.7 (6.6)	18.3 (7.2)	19.9 (7.8)

*Data given in centimeters with inches in parentheses.

**Estimated from regression equations.

1985 MALE*

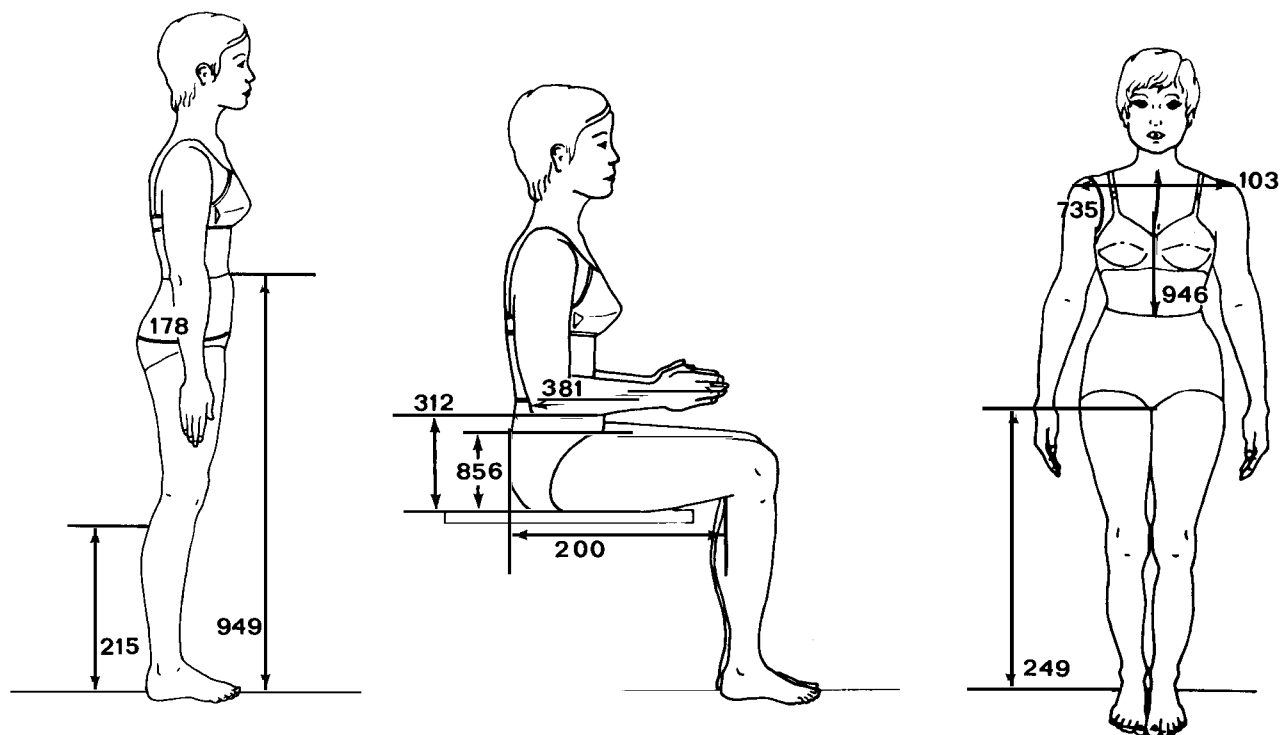


No.	Dimension	5%ile	Mean	95%ile
949	Waist height	99.4 (39.1)	107.2 (42.2)	114.8 (45.2)
249	Grotch height	78.9 (31.1)	85.7 (33.7)	92.6 (36.5)
215	Calf height	32.3 (12.7)	35.8 (14.1)	39.6 (15.6)
103	Biacromial breadth	37.6 (14.8)	40.9 (16.1)	44.0 (17.3)
946	Waist front	37.1 (14.6)	40.6 (16.0)	44.2 (17.4)
735	Scye circumference	44.2 (17.4)	48.7 (19.2)	53.3 (21.0)
178	Buttock circumference	90.3 (35.6)	99.5 (39.2)	108.9 (42.9)
312	Elbow rest height	21.0 (8.3)	25.3 (10.0)	29.7 (11.7)
856	Thigh clearance	14.5 (5.7)	16.8 (6.6)	19.1 (7.5)
381	Forearm-hand length**	45.7 (18.0)	49.1 (19.3)	52.6 (20.7)
200	Buttock-popliteal length	46.4 (18.3)	50.8 (20.0)	55.1 (21.7)

*Data given in centimeters with inches in parentheses.

**Estimated from regression equations.

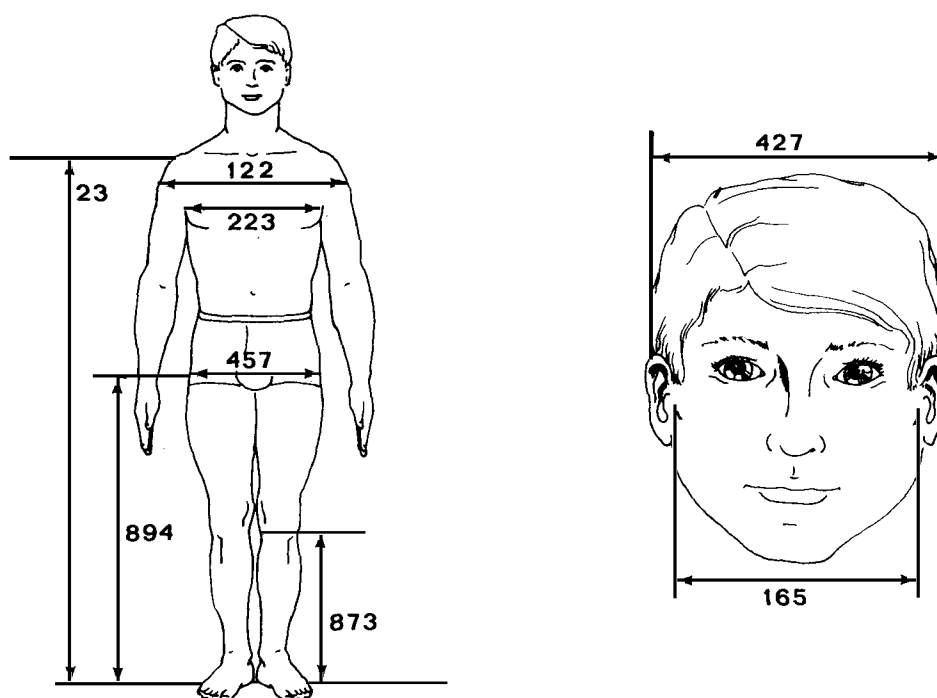
1985 FEMALE*



No.	Dimension	5%ile	Mean	95%ile
949	Waist height	93.1 (36.7)	100.7 (39.6)	108.1 (42.6)
249	Crotch height	67.7 (26.7)	74.4 (29.3)	81.3 (32.0)
215	Calf height**	28.7 (11.3)	33.1 (13.0)	37.5 (14.8)
103	Biacromial breadth	33.4 (13.1)	36.1 (14.2)	38.8 (15.3)
946	Waist front	30.4 (12.0)	33.7 (13.3)	37.1 (14.6)
735	Scye circumference	34.1 (13.4)	37.8 (14.9)	41.9 (16.5)
178	Buttock circumference	86.0 (33.9)	95.1 (37.4)	106.6 (42.0)
312	Elbow rest height	19.2 (7.6)	22.9 (9.0)	27.1 (10.7)
856	Thigh clearance	10.4 (4.1)	12.5 (4.9)	14.9 (5.9)
381	Forearm-hand length**	39.7 (15.6)	42.8 (16.9)	45.9 (18.1)
200	Buttock-popliteal length	43.7 (17.2)	47.9 (18.9)	52.7 (20.7)

*Data given in centimeters with inches in parentheses.

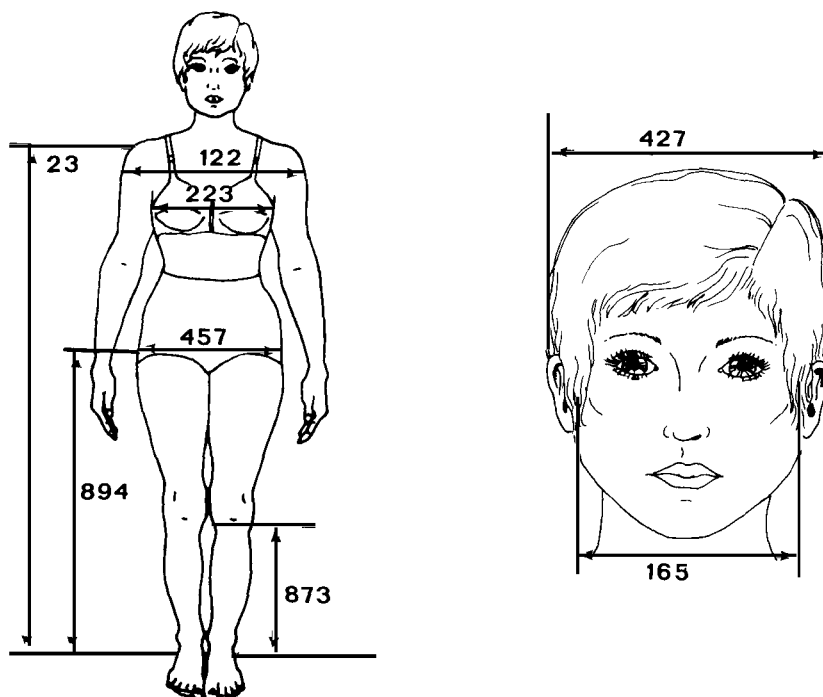
**Estimated from regression equations.



No.	Dimension	5%ile	Mean	95%ile
957	Weight (not pictured) kg. (lbs.)	65.2 (143.7)	81.5 (179.7)	97.7 (215.4)
23	Acromial (shoulder) height	136.5 (53.7)	146.1 (57.5)	155.7 (61.3)
894	Trochanteric height	87.5 (34.4)	94.6 (37.2)	101.8 (40.1)
873	Tibiale height	44.8 (17.6)	48.9 (19.3)	53.0 (20.9)
122	Bideltoid (shoulder) breadth	44.4 (17.5)	48.6 (19.1)	52.9 (20.8)
223	Chest breadth	29.7 (11.7)	33.0 (13.0)	36.7 (14.4)
457	Hip breadth	32.5 (12.8)	35.5 (14.0)	38.8 (15.3)
165	Bizygomatic (face) breadth	13.4 (5.3)	14.3 (5.6)	15.1 (5.9)
427	Head breadth	14.7 (5.8)	15.6 (6.1)	16.6 (6.5)

*Data given in centimeters with inches in parentheses.

1985 FEMALE*

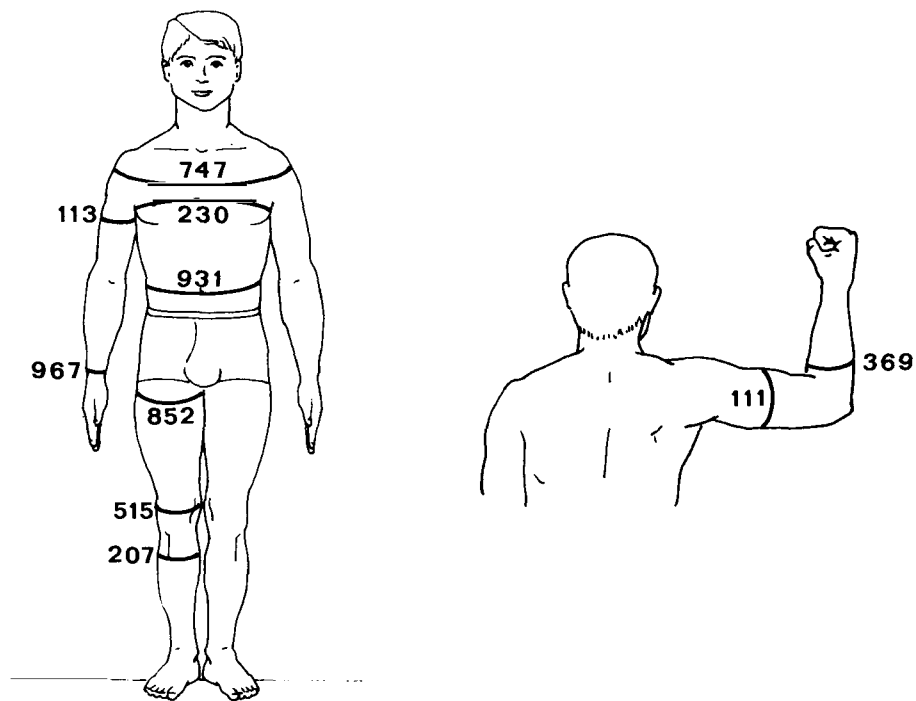


No.	Dimension		5%ile	Mean	95%ile
957	Weight (not pictured)	kg. (lbs.)	47.4 (104.5)	59.7 (131.6)	74.9 (165.1)
23	Acromial (shoulder) height		122.9 (48.4)	132.4 (52.1)	141.4 (55.7)
894	Trochanteric height		75.6 (29.8)	82.8 (32.6)	90.1 (35.5)
873	Tibiale height		38.1 (15.0)	42.1 (16.6)	46.4 (18.3)
122	Bideltoid (shoulder) breadth		38.6 (15.2)	42.4 (16.7)	46.8 (18.4)
223	Chest breadth		25.3 (10.0)	28.5 (11.2)	32.3 (12.7)
457	Hip breadth**		32.0 (3.9)	35.5 (4.3)	39.6 (4.6)
165	Bizygomatic (face) breadth		12.0 (4.7)	13.0 (5.1)	14.0 (5.5)
427	Head breadth		13.7 (5.4)	14.7 (5.8)	15.7 (6.2)

*Data given in centimeters with inches in parentheses.

**Estimated from regression equations.

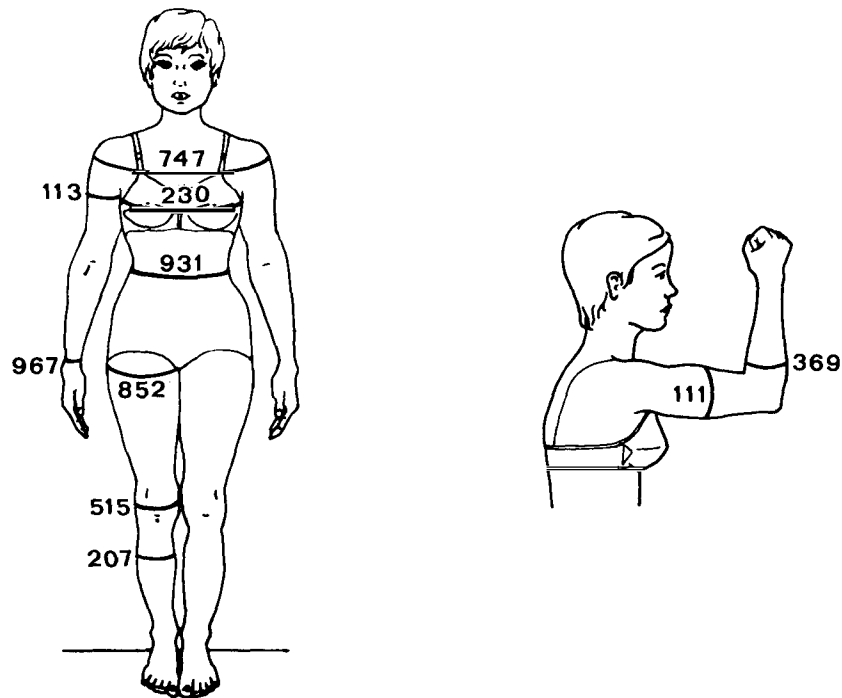
1985 MALE*



No.	Dimension	5%ile	Mean	95%ile
747	Shoulder circumference	109.0 (42.9)	118.5 (46.7)	128.4 (50.6)
230	Chest circumference	89.1 (35.1)	99.1 (39.0)	109.8 (43.2)
931	Waist circumference	76.4 (30.1)	88.4 (34.8)	100.7 (39.6)
852	Thigh circumference	52.1 (20.5)	59.5 (23.4)	67.1 (26.4)
515	Knee circumference	35.6 (14.0)	39.0 (15.4)	42.7 (16.8)
207	Calf circumference	33.8 (13.3)	37.5 (14.8)	41.3 (16.3)
113	Biceps circumference, relaxed	27.2 (10.7)	31.1 (12.2)	35.0 (13.8)
967	Wrist circumference	16.2 (6.4)	17.6 (6.9)	19.3 (7.6)
111	Biceps circumference, flexed	29.4 (11.6)	33.1 (13.0)	36.9 (14.5)
369	Forearm circumference, flexed	27.4 (10.8)	30.0 (11.8)	32.6 (12.8)

*Data given in centimeters with inches in parentheses.

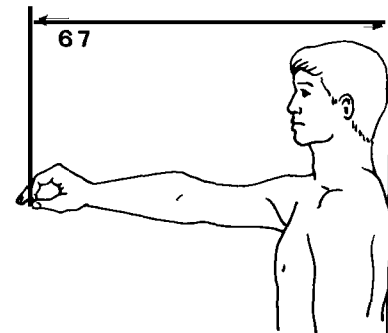
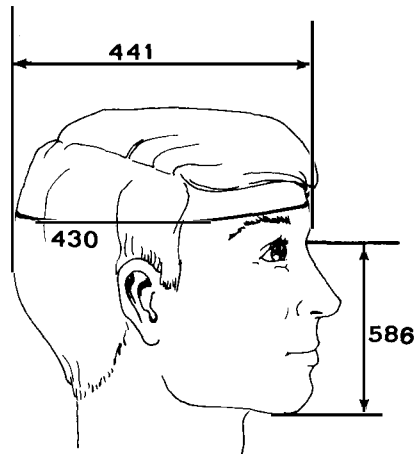
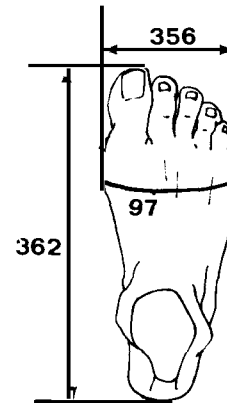
1985 FEMALE*



No.	Dimension	5%ile	Mean	95%ile
747	Shoulder circumference	93.3 (36.7)	101.7 (40.0)	111.8 (44.0)
230	Chest circumference	82.2 (32.4)	91.6 (36.1)	103.6 (40.8)
931	Waist circumference	59.4 (23.4)	68.2 (26.9)	80.4 (31.7)
852	Thigh circumference	49.2 (19.4)	56.3 (22.2)	64.1 (25.2)
515	Knee circumference	33.0 (13.0)	36.7 (14.4)	41.1 (16.2)
207	Calf circumference	30.7 (12.1)	34.3 (13.5)	38.4 (15.1)
113	Biceps circumference, relaxed	22.8 (9.0)	26.3 (10.4)	30.9 (12.2)
967	Wrist circumference	13.8 (5.4)	15.0 (5.9)	16.3 (6.4)
111	Biceps circumference, flexed	23.9 (9.4)	27.5 (10.8)	32.0 (12.6)
369	Forearm circumference, flexed	22.7 (8.9)	25.2 (9.9)	27.8 (10.9)

*Data given in centimeters with inches in parentheses.

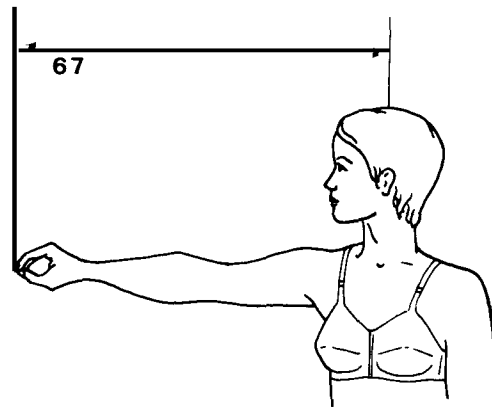
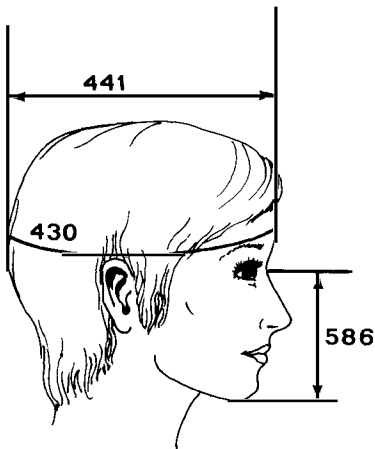
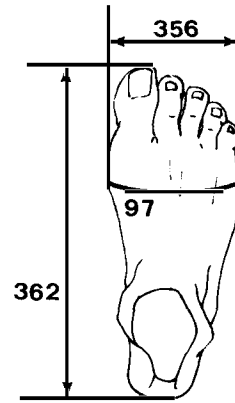
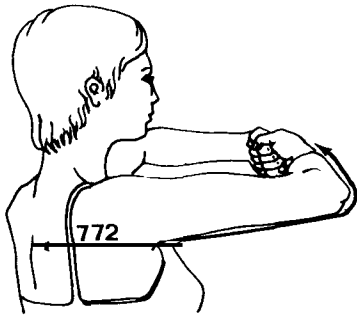
1985 MALE*



No.	Dimension	5%ile	Mean	95%ile
67	Thumb-tip reach	74.3 (29.3)	80.7 (31.8)	87.4 (34.4)
772	Sleeve length	85.7 (33.7)	91.3 (35.9)	97.3 (38.3)
441	Head length	18.8 (7.4)	19.9 (7.8)	21.0 (8.3)
430	Head circumference	55.3 (21.8)	57.6 (22.7)	60.0 (23.6)
586	Menton-sellion (face) length	11.1 (4.4)	12.0 (4.7)	13.0 (5.1)
362	Foot length	25.3 (10.0)	27.2 (10.7)	29.2 (11.5)
356	Foot breadth	9.0 (3.5)	9.8 (3.9)	10.7 (4.2)
97	Ball of foot circumference	23.0 (9.1)	25.0 (9.8)	27.0 (10.6)

*Data given in centimeters with inches in parentheses.

1985 FEMALE*



No.	Dimension	5%ile	Mean	95%ile
67	Thumb-tip reach	67.7 (26.7)	74.3 (29.3)	80.6 (31.7)
772	Sleeve length	74.2 (29.2)	80.0 (31.5)	85.2 (33.5)
441	Head length	17.5 (6.9)	18.6 (7.3)	19.7 (7.8)
430	Head circumference	52.6 (20.7)	55.2 (21.7)	57.9 (22.8)
586	Menton-sellion (face) length	12.6 (9.8)	14.0 (10.8)	15.6 (11.8)
362	Foot length	22.2 (8.7)	24.1 (9.5)	26.1 (10.3)
356	Foot breadth	8.0 (3.1)	8.8 (3.5)	9.7 (3.8)
97	Ball of foot circumference**	21.3 (8.4)	23.3 (9.2)	25.3 (10.0)

*Data given in centimeters with inches in parentheses.

**Estimated from regression equations.

APPENDIX C

DRAWING BOARD MANIKINS

Two-dimensional drawing board manikins are among the most important aids used by the designer in making preliminary as well as fairly complete crew station drawings. The most up-to-date and accurate such manikins are those developed by Kenneth W. Kennedy of the Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio. Acting on a request from the Lyndon B. Johnson Space Center, NASA, Kennedy developed a 5th, 50th and 95th percentile drawing board manikin based on the anticipated 1980-1990 body size distribution of USAF fliers. These manikins provide not only accurate body size dimensions but body length links, segmental centers of rotation and joint range limits. As well, they incorporate adjustments for changes in body size dimensions for sitting and standing design postures.

Figures 1 and 2 illustrate the new manikins (patents applied for). They are designed to represent the USAF rated officers of the 1980-90 time period. Figure 1 is a photograph of one variation, the 5th percentile, with the arm detached to permit an uncluttered view of its parts. Fifth, 50th, and 95th percentile manikins have been designed. A variant of the same manikin, provided with a boot and helmet, is pictured in Figure 2 in the fetal position to illustrate the manikin's mobility and natural body profile in such an extreme position.

The manikins are accurate in at least 25 body size dimensions important in the layout of crew stations. Chief among these are:

- Stature
- Sitting height
- Eye height, sitting
- Functional reach
- Functional reach, extended
- Elbow to grip distance
- Buttock knee length
- Knee height, sitting
- Chest depth
- Waist depth
- Hand, head and foot dimensions

Alternate limbs have been designed and sized to allow the designer to consider variability in body proportions as well as body size in the design of crew stations. Each percentile torso is equipped with three sets of limbs representing the design range. Thus, a 50th percentile manikin could be fitted either with 50th percentile limbs or with a set of arms and legs representing the largest or smallest generally found on that size torso.

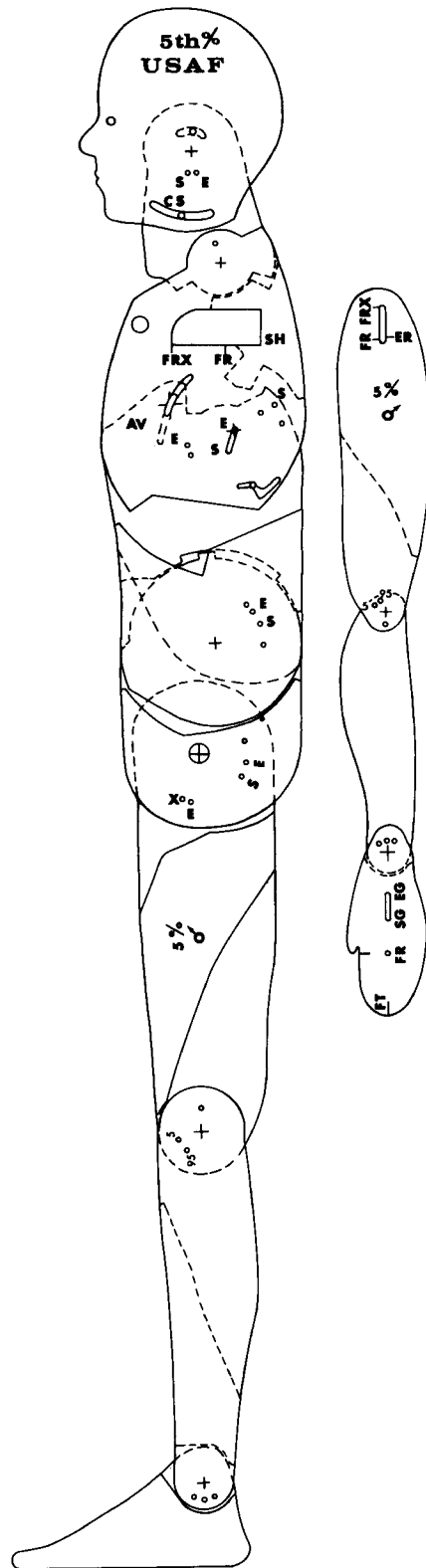


Figure 1. USAF two-dimensional manikin.

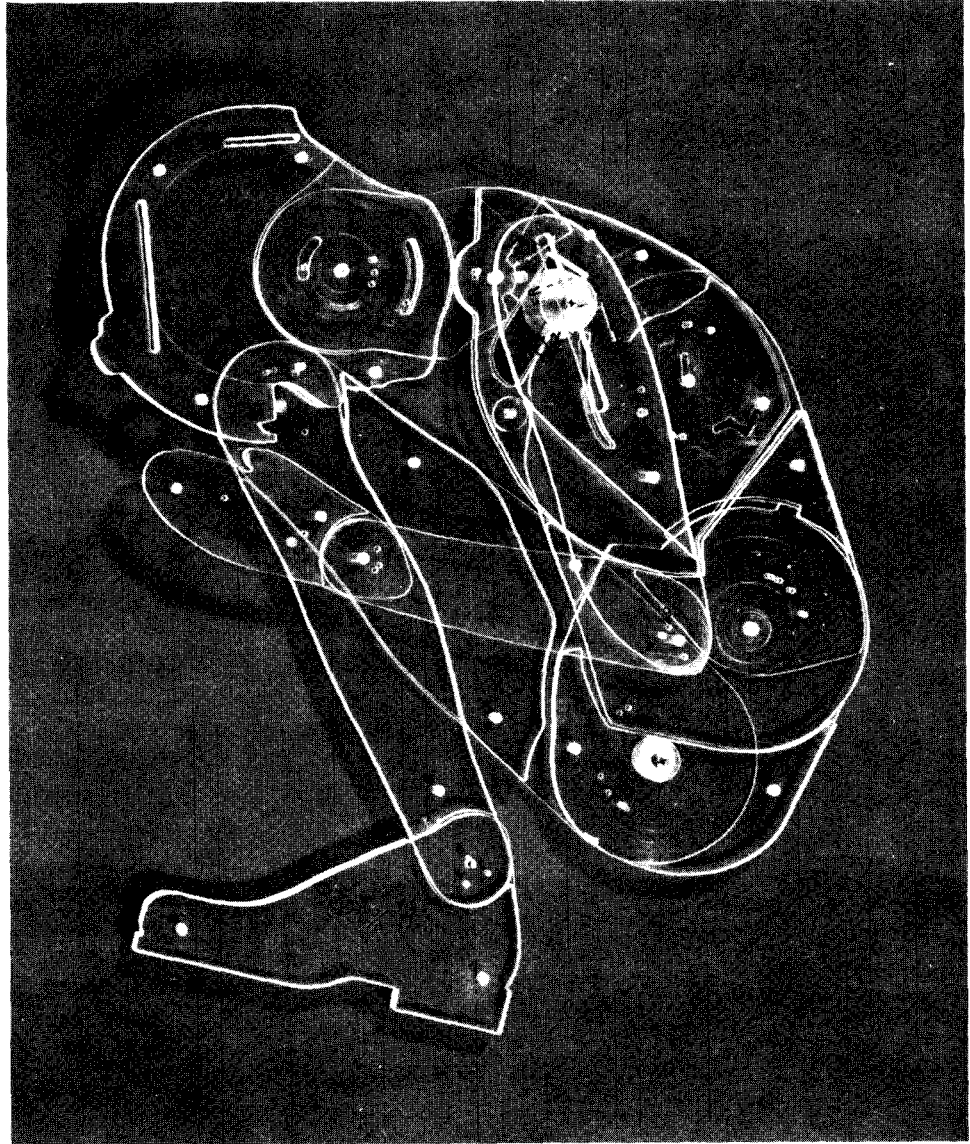


Figure 2. USAF two-dimensional manikin in fetal position.

The manikins are obviously useful in laying out the geometry of crew stations. They are also valuable in evaluating a crew station in terms of tolerance to G forces because they provide the capability to track the positions of the eye, the carotid sinuses, and the aortic valves. The heights of the eye-heart and carotid sinus-heart columns can be calculated.

To provide the USAF manikin with the desired features and to provide for realistic intra-torso mobility and the greatest possible stability on the drawing board, it was necessary to design the manikin in three layers. With this design, the head, torso, and legs on each side can be uniplanar. Since the convention is to design cockpits and other vehicle driving stations "face left," the symbology has been designed for that direction. The arm is fastened to the manikin's left side. Should the occasion arise to design face right, the arm can be removed and fastened to the other side.

The plans for this manikin are not simple, nor can useful models be made with cardboard and scissors. They require precise and rather skilled care in their fabrication to assure the desired results. Although somewhat expensive to fabricate, a well-made manikin is an extremely useful and valuable design tool. Plans may be obtained from:

6570 Aerospace Medical Research Laboratory
ATTN: Mr. Kenneth W. Kennedy
Wright-Patterson AFB, Ohio 45433

For the casual user and for the designer who does not need the full capabilities of the more complicated USAF 2-D manikins, a simpler design has been prepared and is presented in Figures 3, 4 and 5. While the pictured patterns do not embody all the features of the more complicated manikins, they are much less costly to produce and still provide accurate body dimensional and mobility data readily useful to the designer. These illustrations are accurate as presented to allow the user to duplicate the patterns, cut them out, and actually make up serviceable 1/4 scale, 5th, 50th, and 95th percentile manikins.

For users who wish to assemble the cut-out manikins, the following symbology should be understood:

A target, $\oplus$, indicates a joint center and should be drilled in accordance with available fasteners.

Two targets connected by a straight line, such as in the upper torso and upper arm, represent a slot of a convenient diameter to permit slippage of the fastener. This slot permits the arm to be placed in both the functional reach and functional reach, extended positions.

Index hole = $\bullet$; Adjustment hole = $\circ$.

"E," which appears adjacent to adjustment holes in the head, neck, torso, and lower limb, indicates adjustment holes for the erect body position, both standing and seated. When the index holes ($\bullet$) are aligned with the adjustment hole ($\circ$) marked "E," the manikin is adjusted to a normal

erect body position. When the index holes are aligned with the other holes, the joint in consideration is at an extreme of its motion capability.

It is extremely important to follow instructions when fabricating these manikins. With the manikins in the standing erect position (as illustrated), the following instructions apply.

Joint A (Head):

Drill index hole through both top and bottom pieces.
Drill adjustment holes through bottom piece only.
Scribe "E" on bottom piece.

Joint B (Neck):

Drill index hole through both pieces.
Drill adjustment holes through bottom piece.
Scribe "E" on bottom piece.

Joint C (Mid-chest--below arm attachment slot):

Drill index hole through both pieces.
Drill adjustment holes through top piece.
Scribe "E" on top piece.

Joint D (Abdomen):

Drill index hole through both pieces.
Drill adjustment holes through bottom piece.
Scribe "E" on bottom piece.

Joint E (Hip):

Drill index hole through both pieces.
Drill adjustment holes through bottom piece.
Scribe "E"s and "X" on bottom piece.

Joint F (Knee):

Drill index hole through both pieces.
Drill adjustment holes through bottom piece.
Scribe "E", "5" and "95" on bottom piece.

Joint G (Ankle):

Drill index hole through top piece only.
Drill adjustment holes through bottom piece.

Joint H (Elbow):

Drill index hole through both pieces.
Drill adjustment holes through top piece.
Scribe "5" and "95" on top piece.

Joint I (Wrist):

Drill index hole through top piece only .
Drill adjustment holes through bottom piece.

When the manikin is in use, functional reach ("FR" mark on hand) and finger tip reach ("FT" mark on hand) can be accurately simulated by aligning "FR" in the slot in the upper arm with "FR" in the slot in the upper torso, with the arm straight and extended forward. Functional reach extended ("FRX" mark on the hand) and finger tip reach can be simulated by similarly aligning "FRX" on the torso and arm.

When the index hole is aligned with "5" or "95" at the knee or elbow, 5th and 95th percentile knee and elbow flexion, respectively, are achieved. When in the "E" position, the joint is fully extended.

When the index hole at the hip is adjusted to one of the two "E" adjustment holes, that joint is in the seated or standing erect position; when adjusted to "X", the hip is hyperextended. When at one of the remaining two adjustment holes, the hip is either normally extended or flexed.

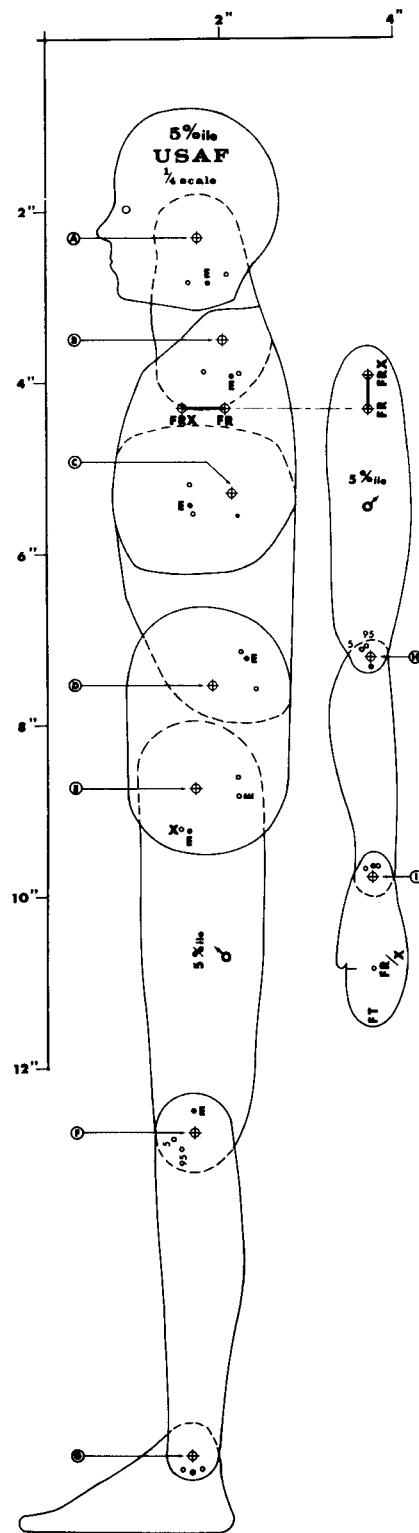


Figure 3. Two-dimensional 5%ile USAF manikin (simplified version).

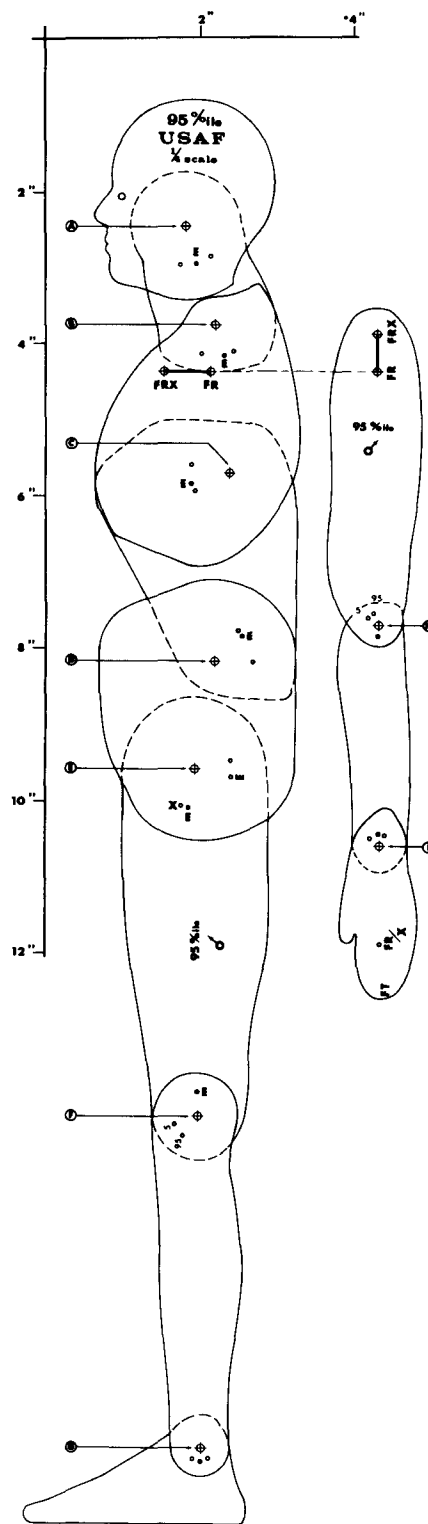


Figure 4. Two-dimensional 50%ile USAF manikin (simplified version).

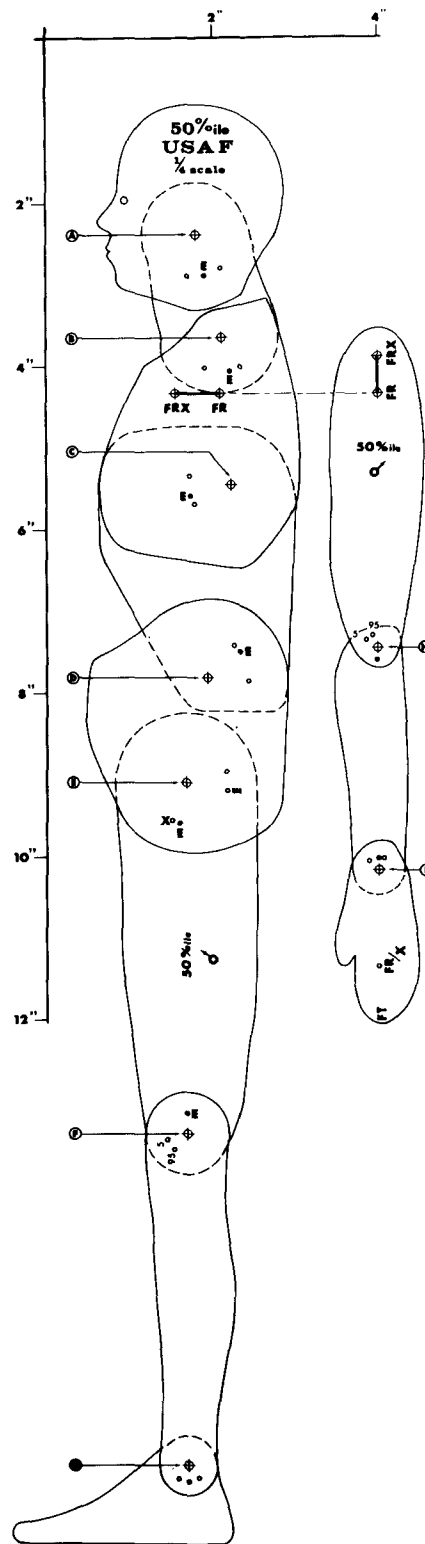


Figure 5. Two-dimensional 95th percentile USAF manikin (simplified version).