METRIC

NOTICE OF CHANGE

MIL-STD-1472D
NOTICE 2
30 June 1992

MILITARY STANDARD

HUMAN ENGINEERING DESIGN CRITERIA FOR MILITARY SYSTEMS, EQUIPMENT AND FACILITIES

TO ALL HOLDERS OF MIL-STD-1472D:

1. THE FOLLOWING PAGES OF MIL-STD-1472D HAVE BEEN REVISED OR CREATED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
v	14 March 1989	v	REPRINTED WITHOUT CHANGE
vi	30 June 1992	vi	14 March 1989
87	14 March 1989	87	REPRINTED WITHOUT CHANGE
88	30 June 1992	88	14 March 1989
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138	14 March 1989	138	REPRINTED WITHOUT CHANGE
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237	30 June 1992	237	14 March 1989
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NEW PAGE	DATE	SUPERSEDED PAGE	DATE
284	30 June 1992	284	14 March 1989
285	30 June 1992	285	14 March 1989
286	20 March 1991	286	REPRINTED WITHOUT CHANGE

2. MAKE THE FOLLOWING PEN AND INK CHANGES:

a. Page iv, para 5.4.6, change "119" to "120."

b. Page 16, para 3.67, 2nd line, change "test" to "text."

c. Page 44, para 5.2.3.3.3, 4th line, add space before "bat."

d. Page 44, para 5.2.3.3.7, 5th line, change "allitude" to "attitude."

e. Page 44, para 5.2.4, 3rd line, change "5.16" to "5.15."

f. Page 60, para 5.3.5.4, 5th line, change "maybe" to "may be."

g. Page 60, para 5.3.5.4, 5th line, change "3.24" to "3.51."

h. Page 159, para 5.7.7.6, 9th line, change "75mm (3 inches)" to "150 mm (6 inches)."

i. Page 171, Table XXIII, delete comma after "digital."

j. Page 175, para 5.8.3.2, 2nd line, change "MIL-S-008806" to "MIL-STD-1789."

k. Page 195, para 5.9.11.4.1, 3rd line, change "adjustment" to "value for females."

l. Page 215, para 5.11.1.2.2, 5th line, change "16.3 kg (36 lb)" to "18.5 kg (41 lb)."

m. Page 215, para 5.11.1.2.2, 6th line, change "24.5 kg (54 lb)" to "27.7 kg (61 lb)"

n. Page 241, para 5.14.2.4.1, 1st and 4th sentences, change "restrains" to "restraints."

o. Page 241, para 5.14.2.4.3, 2nd line, change "2∏rad" to "2π rad."

p. Page 241, para 5.14.2.4.5, 2nd line, change "actuation" to "ability to actuate."

q. Page 263, para 5.15.3.8.2, add "5.3.2.4."

r. Page 263, para 5.15.3.8.5, change "5.3.3.1.1" to "5.3.3.1"

s Page 264, para 5.15.4.1.1, change "5.15.8" to "5.15.9"

t. Page 275, para 5.15.8.13.8, 3rd line, add "(not to exceed six months)."

u. Page 307, add "Covert operations- - - - -5.13.9 237"

v. Page 372, add "Stealth operations - - -.-5.13.9 237"

w. Page 377, add "Trainers - - - - - - - - - - - -5.13.8 237"

3. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

4. Holders of MIL-STD-1472D will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military standard is completely revised or cancelled.

Custodians:
Army - MI
Navy - AS
Air Force - 11

Preparing activity:
Army - MI

(Project HFAC-0048)

Review activities:
Army -AR, AT, AV, CR, ER, GL, ME, MD, MR, TE, TM, EA
Navy- EC, MC, MS, OS, PE, SH, TD
Air Force13, 14, 19, 26

User activities:
Army-AL
Navy-YD

Civilian agencies:
NASA-MSFC
DOT-RDS

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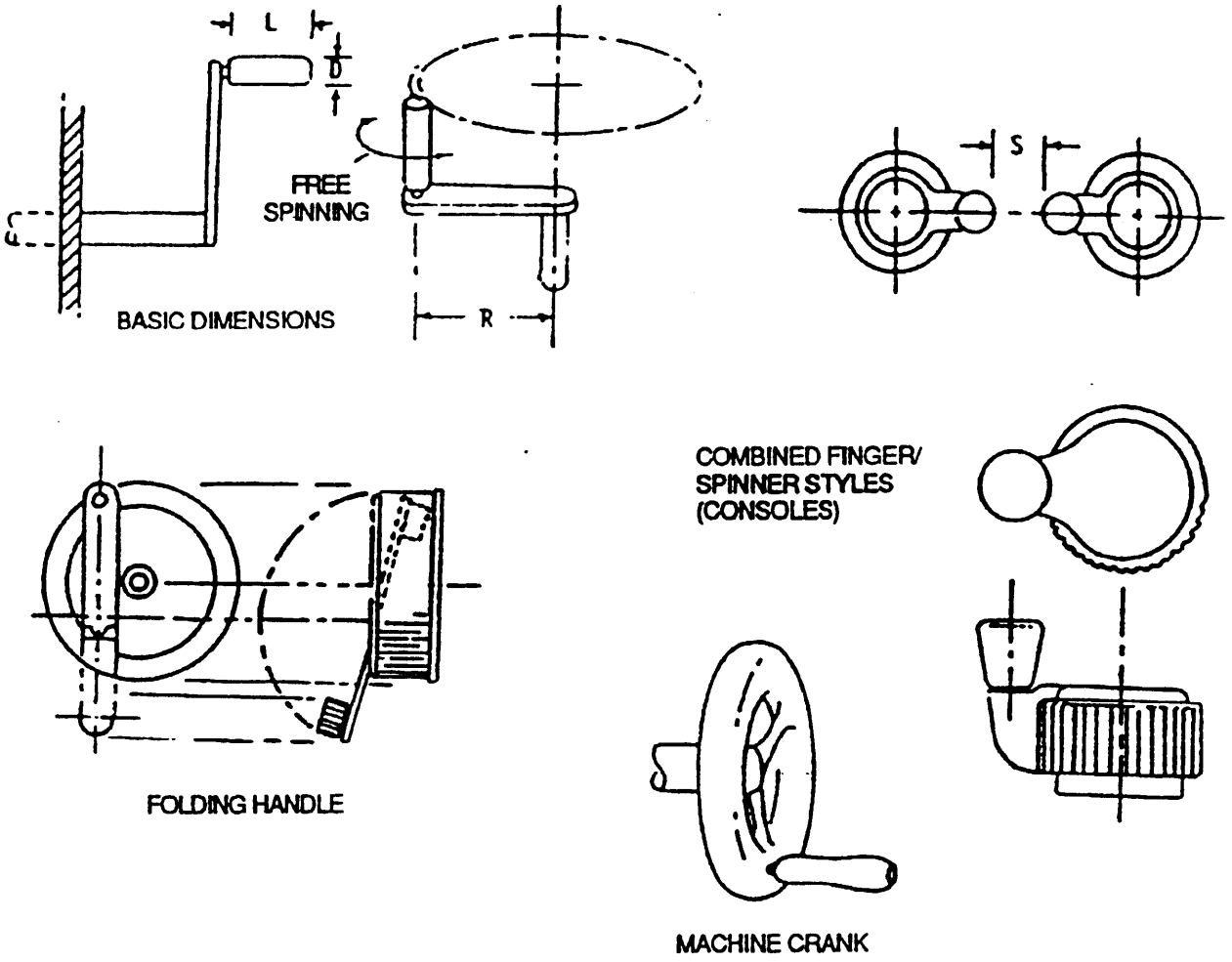

LOAD	SPECIFICATION	HANDLE				R, TURNING RADIUS			
		L, LENGTH		D, DIAMETER		RATE BELOW 100 RPM		RATE ABOVE 100 RPM	
		mm	in.	mm	in.	mm	in.	mm	in.
LIGHT LOADS Less than 22 N: (5 lb). (Wrist and finger movement)	MINIMUM	25	1	10	3/8	38	$1\frac{1}{2}$	13	1/2
	PREFERRED	38	$1\frac{1}{2}$	13	1/2	75	3	65	$2\frac{1}{2}$
	MAXIMUM	75	3	16	5/8	125	5	115	$4\frac{1}{2}$
HEAVY LOADS: More than 22 N (5 lb). (Arm movement)	MINIMUM	75	3	25	1	190	$7\frac{1}{2}$	125	5
	PREFERRED	95	3-3/4	25	1	–	–	–	–
	MAXIMUM	–	–	38	1	510	20	230	9

S, Separation between adjacent controls: 75 mm (3") minimum.

FIGURE 10. CRANKS

5.4.2.2.5.6 Steering wheel shape. Except for established uses in submarines, armored combat vehicles, aircraft, and other applications where maximum wheel deflection does not exceed ±2/3 πrad (120°), all steering wheels shall be round.

5.4.2.2.5.7 Power steering failure. Steering systems shall be designed with sufficient mechanical advantage to meet the force requirements of Table IX, even when the primary operating mode is power assisted, i.e., the operator shall be able to steer the vehicle to a safe stop in the event of a power failure.

5.4.2.2.5.8 Steering ratio. Steering systems should be designed so that the maximum turning limits of the vehicle can be achieved with no more than $3\frac{1}{2}$ turns if consistent with force limits of Table IX.

5.4.3 Linear controls.

5.4.3.1 Discrete linear controls.

5.4.3.1.1 Push buttons (finger or hand operated).

5.4.3.1.1.1 Use. Push buttons should be used when a control or an array of controls is needed for momentary contact or for actuating a locking circuit, particularly in high-frequency-of-use situations. Push buttons should not be used for discrete control where the functions status is determined exclusively by position of the switch. (i.e., An on-off push buton that is pressed in and retained to turn a circuit on and pressed again to releast the push button and turn the circuit off.)

5.4.3.1.1.2 Shape. The push button surface should normally be concave (indented) to fit the finger. When this is impractical, the surface shall provide a high degree of frictional resistance to prevent slipping.

5.4.3.1.1.3 Positive indication. A positive indication of control actuation shall be provided (e.g., snap feel, audible click, or integral light).

5.4.3.1.1.4 Channel or cover guard. A channel or cover guard shall be provided when it is imperative to prevent accidental actuation of the controls. When a cover guard is in the open position, it shall not interfere with operation of the protected device or adjacent controls.

5.4.3.1.1.5 Dimensions, resistance, displacement, and separation. Except for use of push buttons in keyboards, control dimensions, resistance, displacement, and separation between adjacent edges of finger or hand-operated push buttons shall conform to the criteria in Figure 11.

5.4.3.1.1.6 Interlocks or barriers. Mechanical interlocks or barriers may be used instead of the spacing required by Figure 11.

5.4.3.1.2 Foot operated switches.

5.4.3.1.2.1 Use. Foot-operated switches should be used only where the operator is likely to have both hands occupied when switch actuation may be

maximum force requirements shall not exceed those specified in Figure 21, and should be corrected, where applicable, for females. (Two-thirds of each value shown is considered to be a reasonable adjustment.)

5.4.4.3 Foot controls. Where foot controls requiring high control forces are to be used, the push force push exerted by the leg depends on the thigh angle and the knee angle. Figure 22 specifies the mean maximum push at various knee and thigh angles. The maximum push is at about the 160 degree angle, referred to as the limiting angle. The values of Figure 22 apply to males only and should be corrected for females. (Two-thirds of each value is considered to be a reasonable value for females.)

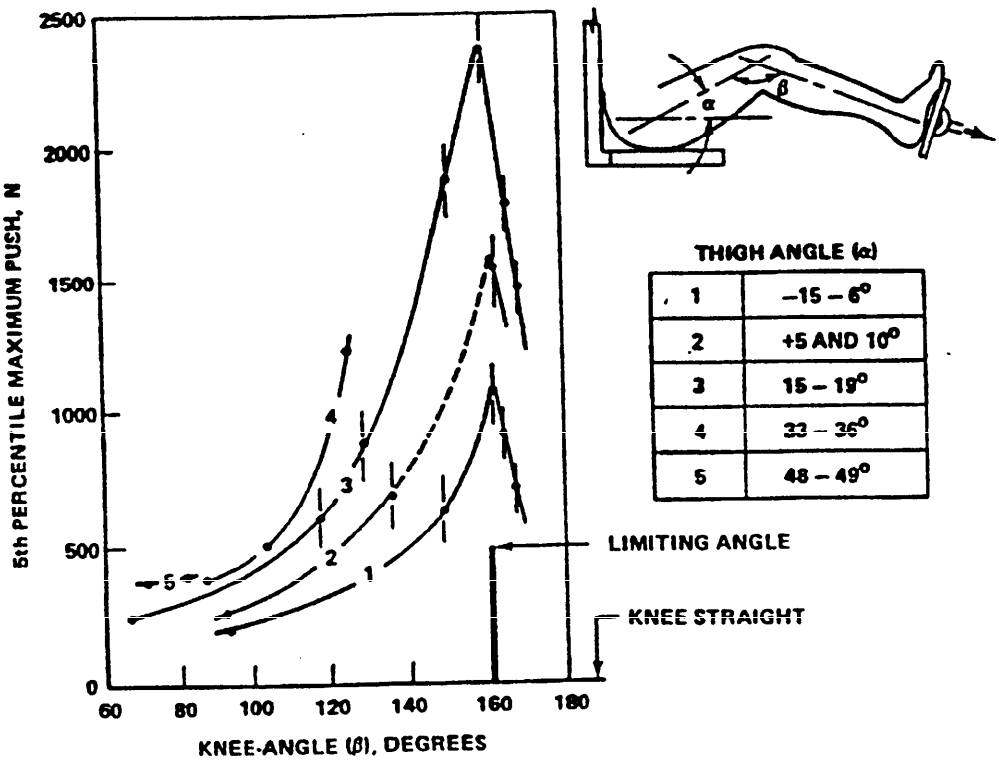

FIGURE 22. LEG STRENGTH AT VARIOUS KNEE AND THIGH ANGLES (5th PERCENTILE MALE)

5.4.5 Miniature controls

5.4.5.1 Use. Miniature controls may be used only when severe space limitations exist. Miniature controls shall not be used when available space is adequate for standard-sized controls or when heavy gloves or mittens will be worn.

5.4.5.2 Dimensions, resistance, displacement and separation. When design constraints dictate the use of miniature controls, the dimensions and separation of the controls shall be the maximum permitted by the available space up to the maxima prescribed herein for standard-sized controls. Resistance and displacement of miniature controls should conform to the criteria specified for the standard size of that type of control.

5.4.5.3 Other requirements. Other design considerations (e.g., labeling, orientation) shall conform to the requirements specified for the standard size of the control.

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5.4.6 Touch-screen controls for displays

5.4.6.1 Use. Touch-screen control may be used to provide an overlaying control function to data display devices such as CRTs, dot matrix/segmented displays, electroluminescent displays, programmable indicators, or other display devices where direct visual reference access and optimum direct control access are desired.

5.4.6.2 Luminance transmission. When used, touch-screen displays shall have sufficient luminance transmission to allow the display with touch-screen installed to be clearly readable in the intended environment and meet the display luminance requirements herein.

5.4.6.3 Positive indication. A positive indication of touch-screen actuation shall be provided to acknowledge the system response to the control action. Visual feedback should be provided for touch-screen actuation.

5.4.6.4 Dimensions and separation. The dimensions and separation of responsive areas of the touch-screen shall conform to S1, S2 and Bw of Figure 14 for a seated operator in a benign environment. (An adverse environment may warrant larger sizes and separations.)

5.4.6.5 Resistance. Force required to operate force-actuated touch-screens shall conform to the alphanumeric resistance limits of Table X.

5.4.6.6 System Display Response Time. System display response time shall be not more than 0.25 seconds.

5.6 Anthropometry.

5.6.1 General. Design and sizing shall ensure accommodation, compatibility, operability, and maintainability by the user population. Generally, design limits shall be based upon a range from the 5th percentile female to the 95th percentile male values for critical body dimensions, as appropriate, except for special populations (see 5.6.4). For any body dimension, the 5th percentile value means that five percent of the population will be equal to or smaller than that value, and 95 percent will be larger; conversely, the 95th percentile value indicates that 95 percent of the population will be equal to or smaller than that value and five percent will be larger. Therefore, use of a design range from the 5th to 95th percentile values will theoretically provide coverage for 90 percent of the user population for that dimension. Where two or more dimensions are used simltaneously as design parameters, appropriate multivariate data and techniques should be utilized. (See Appendix for representative references.) The limited anthropometric data presented in this section in Figures 23 through 28 and Tables XIII through XVIII are intended to provide general design guidance only. DOD-HDBK-743 should be consulted for more extensive data. Use of these data shall take the following into consideration:

a. The nature, frequency, and difficulty of the related tasks to be performed by the operator or wearer of the equipment.

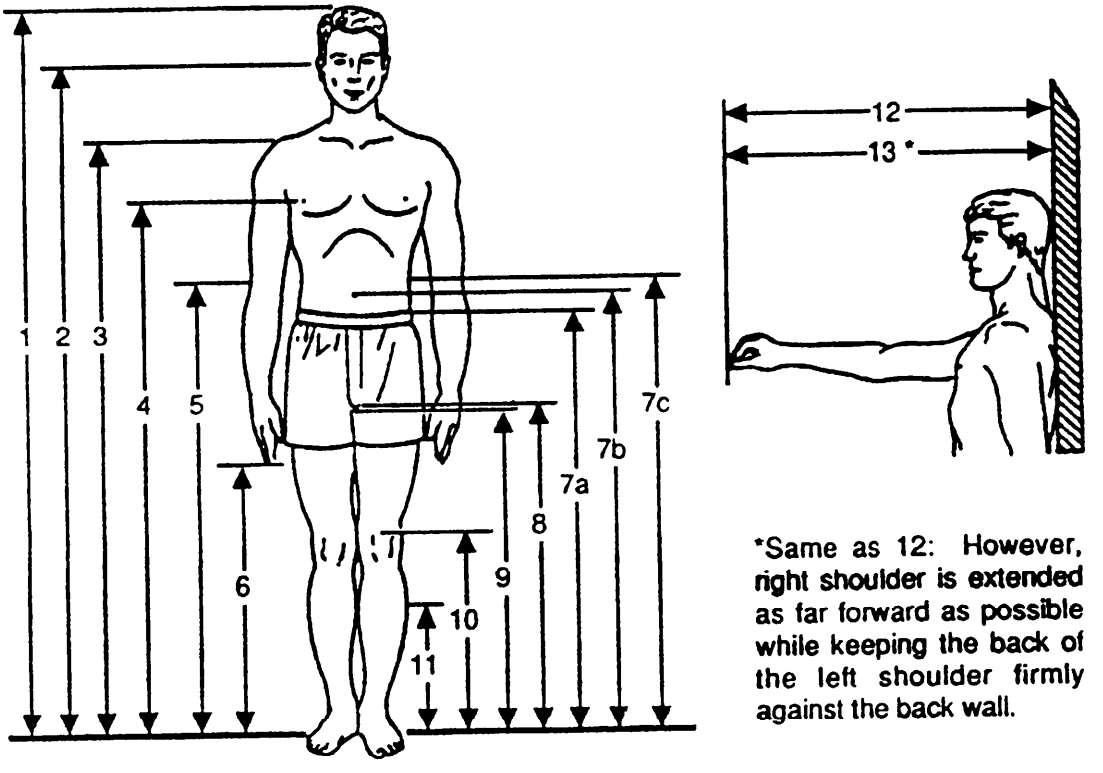
b. The position of the body during performance of these tasks.

c. Mobility or flexibility requirements imposed by these tasks.

d. Increments in the design-critical dimensions imposed by the need to compensate for obstacles, projections, etc.

e. Increments in the design-critical dimensions imposed by protective clothing or equipment, packages, lines, padding, etc.

5.6.2 Anthropometric Data. The anthropometric data presented in Tables XIII through XVIII are nude body dimensions; data are given in centimeters, with equivalent values in inches beneath in parentheses. The anthropometric data shown in these tables were compiled and collated from several sources. The data on "General Forces - Male" were compiled from the 1988 Anthropometric Survey of U.S. Army Personnel (ANSUR), the 1966 Anthropometric Survey of U.S. Marines and the 1965 Anthropometric Survey of U.S. Air Force male officers and enlisted personnel. The data on "General Forces - Female" were compiled from the ANSUR and the 1968 Anthropometric Survey of U.S. Air Force female officers and enlisted personnel. The data on "Army Pilots - Male" were compiled from a subset of pilots from the ANSUR data pool. The data on "Army Pilots - Female" were compiled from a subset of women, adjusted to match the demographic distribution of current female Army pilots, from the ANSUR data pool who met the body size requirements for entry into pilot training. The data on "Air Force Pilots - Male" were compiled from the 1967 Survey of USAF male rated officers. The data on "Air Force Pilots - Female" were compiled from a subset of the 1968 Survey of USAF female officers and enlisted personnel who met the body size requirements for entry into USAF Undergraduate Pilot Training. Data voids and omitted line numbers within these tables represent measurements which were not taken or for data not available.



*Same as 12: However, right shoulder is extended as far forward as possible while keeping the back of the left shoulder firmly against the back wall.

FIGURE 23. Standing Body Dimensions

TABLE XIII. STANDING BODY DIMENSIONS

A. GENERAL FORCES

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
WEIGHT, kgs (lbs)	61.6 (135.8)	46.4 (102.3)	98.1 (216.3)	77.0 (169.8)
1 STATURE	164.5 (64.8)	152.4 (60.0)	187.1 (73.7)	173.7 (68.4)
2 EYE HEIGHT (STANDING)	152.8 (60.2)	141.5 (55.7)	174.3 (68.6)	162.1 (63.8)
3 SHOULDER (ACROMIALE) HEIGHT	134.2 (52.8)	123.0 (48.4)	154.6 (60.9)	143.2 (56.4)
4 CHEST (NIPPLE) HEIGHT *	118.6 (46.7)	108.9 (42.9)	137.3 (54.1)	127.3 (50.1)
5 ELBOW (RADIALE) HEIGHT	102.3 (40.3)	96.1 (37.8)	119.9 (47.2)	111.0 (43.7)
6 FINGERTIP (DACTYLION) HEIGHT	59.1 (23.3)	55.1 (21.7)	72.4 (28.5)	67.0 (26.4)
7a WAIST (ILIOCRISTALE) HEIGHT	95.3 (37.5)	91.1 (35.9)	115.9 (45.6)	107.1 (42.2)
7b WAIST (OMPHALION) HEIGHT	97.7 (38.5)	90.3 (35.6)	114.3 (45.0)	106.5 (41.9)
7c WAIST (NATURAL INDENTATION) HEIGHT	104.3 (41.1)	97.3 (38.3)	121.3 (47.8)	114.3 (45.0)
8 CROTCH HEIGHT	75.3 (29.6)	68.1 (26.8)	91.8 (36.1)	84.6 (33.3)
9 GLUTEAL FURROW HEIGHT	73.6 (29.0)	66.4 (26.1)	89.2 (35.1)	81.7 (32.2)
10 KNEE (MID-PATELLA) HEIGHT	46.1 (18.1)	41.7 (16.4)	55.2 (21.7)	50.3 (19.8)
11 CALF HEIGHT	31.6 (12.4)	27.8 (10.9)	40.6 (16.0)	35.7 (14.1)
12 FUNCTIONAL (THUMBTIP) REACH	71.7 (28.2)	67.7 (26.7)	88.6 (34.9)	80.5 (31.7)
13 FUNCTIONAL REACH, EXTENDED	80.5 (31.7)	73.5 (28.9)	94.2 (37.1)	92.3 (36.3)

*Bustpoint height for women

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TABLE XIII. STANDING BODY DIMENSIONS (continued)

B. ARMY PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
WEIGHT, kgs (lbs)	64.5 (142.2)	51.2 (112.9)	97.3 (214.5)	81.1 (178.8)
1 STATURE	165.9 (65.3)	160.9 (63.3)	188.4 (74.2)	175.7 (69.2)
2 EYE HEIGHT (STANDING)	153.7 (60.5)	149.9 (59.0)	176.2 (69.4)	164.1 (64.6)
3 SHOULDER (ACROMIALE) HEIGHT	135.7 (53.4)	131.3 (51.7)	155.7 (61.3)	144.4 (56.9)
4 CHEST (NIPPLE) HEIGHT *	119.3 (47.0)	115.1 (45.3)	137.2 (54.0)	128.2 (50.5)
5 ELBOW (RADIALE) HEIGHT	104.8 (41.3)	101.0 (39.8)	120.4 (47.4)	112.7 (44.4)
6 FINGERTIP (DACTYLION) HEIGHT	60.2 (23.7)	58.3 (23.0)	72.0 (28.3)	68.7 (27.0)
7a WAIST (ILIOCRISTALE) HEIGHT	100.0 (39.4)	97.5 (38.4)	116.3 (45.8)	107.7 (42.4)
7b WAIST (OMPHALION) HEIGHT	98.6 (38.8)	96.3 (37.9)	114.9 (45.2)	107.2 (42.2)
7c WAIST (NATURAL INDENTATION) HEIGHT	105.3 (41.5)	102.8 (40.5)	121.4 (47.8)	115.5 (45.5)
8 CROTCH HEIGHT	77.4 (30.5)	75.5 (29.7)	92.1 (36.3)	83.9 (33.0)
9 GLUTEAL FURROW HEIGHT	74.6 (29.4)	72.5 (28.5)	88.7 (34.9)	81.2 (32.0)
10 KNEE (MID-PATELLA) HEIGHT	46.5 (18.3)	44.8 (17.6)	54.8 (21.6)	50.3 (19.8)
11 CALF HEIGHT	31.9 (12.6)	29.3 (11.5)	38.5 (15.2)	35.1 (13.8)
12 FUNCTIONAL (THUMBTIP) REACH	74.0 (29.1)	71.1 (28.0)	86.3 (34.0)	79.7 (31.4)
13 FUNCTIONAL REACH, EXTENDED	80.2 (31.6)	77.4 (30.5)	92.8 (36.6)	86.0 (33.9)

*Bustpoint height for women

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TABLE XIII. STANDING BODY DIMENSIONS (concluded)

C. AIR FORCE PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
WEIGHT, kgs (lbs)	63.6 (140.2)	51.0 (112.4)	95.6 (210.8)	67.1 (147.9)
1 STATURE	167.2 (65.8)	163.3 (64.3)	187.7 (73.9)	175.8 (69.2)
3 SHOULDER (ACROMIALE) HEIGHT	135.7 (53.4)	131.6 (51.8)	154.8 (60.9)	143.9 (56.7)
4 CHEST (NIPPLE) HEIGHT *	120.8 (47.6)	117.5 (46.3)	138.1 (54.4)	130.4 (51.3)
5 ELBOW (RADIALE) HEIGHT	104.8 (41.3)		120.0 (47.2)	
6 FINGERTIP (DACTYLION) HEIGHT	61.5 (24.2)		73.2 (28.8)	
7a WAIST (ILIOCRISTALE) HEIGHT	101.3 (39.9)		117.2 (46.1)	
7b WAIST (OMPHALION) HEIGHT	98.7 (38.9)		114.3 (45.0)	
7c WAIST (NATURAL INDENTATION) HEIGHT		99.3 (39.1)		110.5 (43.5)
8 CROTCH HEIGHT	78.3 (30.8)	72.6 (28.6)	92.0 (36.2)	83.4 (32.8)
9 GLUTEAL FURROW HEIGHT	74.6 (29.4)	70.4 (27.7)	87.9 (34.6)	81.5 (32.1)
10 KNEE (MID-PATELLA) HEIGHT	45.7 (18.0)		53.9 (21.2)	
11 CALF HEIGHT	32.0 (12.6)		39.3 (15.5)	
12 FUNCTIONAL (THUMBTIP) REACH	73.9 (29.1)	71.1 (28.0)	87.0 (34.3)	81.9 (32.2)
13 FUNCTIONAL REACH, EXTENDED	82.3 (32.4)	79.8 (31.4)	97.3 (38.3)	94.0 (37.0)

*Bustpoint height for women

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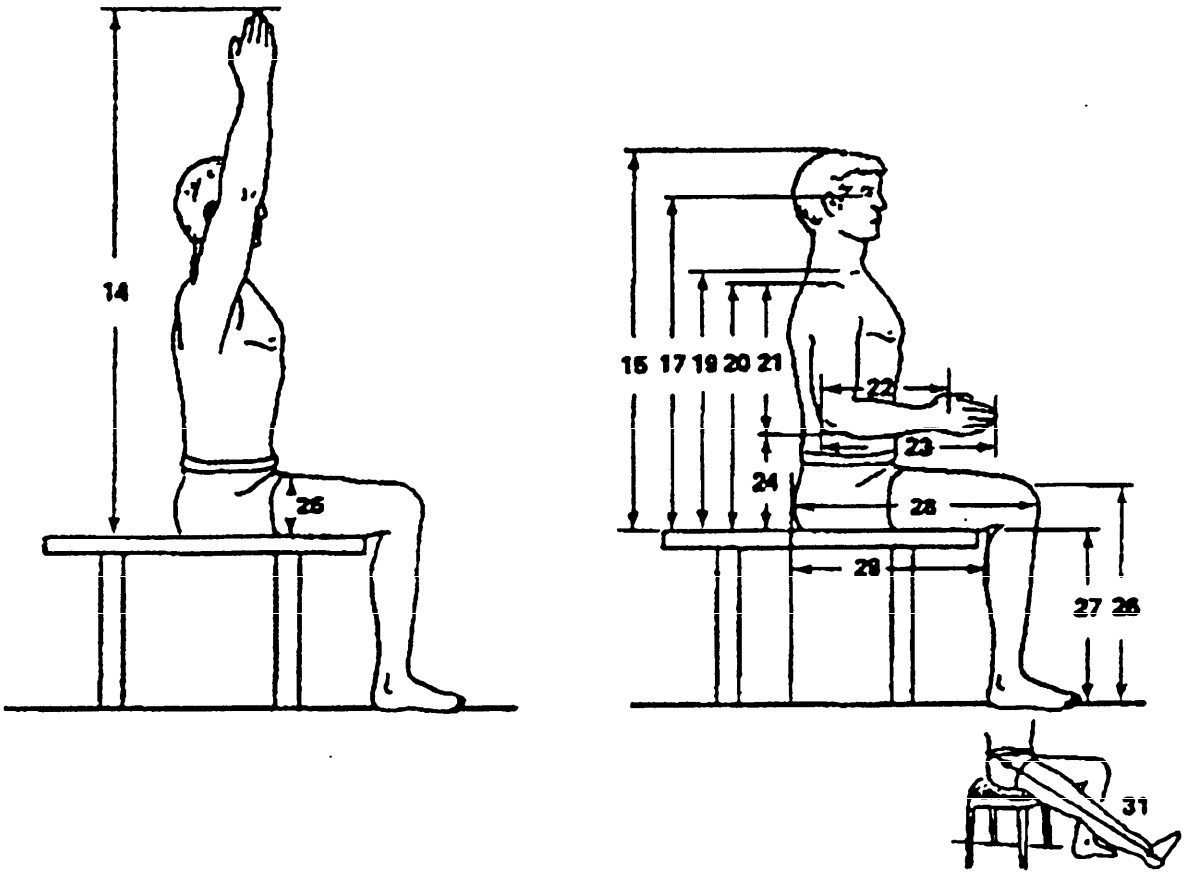

Dimension 16 — Sitting eye height (relaxed) is not shown on figure.

Dimension 30 — not used.

FIGURE 24. Seated Body Dimensions

TABLE XIV. SEATED BODY DIMENSIONS

A. GENERAL FORCES

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
14 VERTICAL ARM REACH, SITTING	128.6 (50.6)	123.3 (48.5)	153.2 (60.3)	141.8 (55.8)
15 SITTING HEIGHT, ERECT	85.2 (33.5)	79.5 (31.3)	97.2 (38.3)	91.0 (35.8)
16 SITTING HEIGHT, RELAXED		78.9 (31.1)		89.7 (35.3)
17 EYE HEIGHT SITTING, ERECT	72.9 (28.7)	68.5 (27.0)	85.2 (33.5)	79.4 (31.3)
19 MID-SHOULDER HEIGHT	57.2 (22.5)	53.9 (21.2)	68.6 (27.0)	63.1 (24.8)
20 SHOULDER HEIGHT, SITTING	54.9 (21.6)	50.9 (20.0)	64.6 (25.4)	60.4 (23.8)
21 SHOULDER-ELBOW LENGTH	34.0 (13.4)	28.3 (11.1)	40.2 (15.8)	36.5 (14.4)
22 ELBOW-GRIP LENGTH	33.2 (13.1)	30.0 (11.8)	39.1 (15.4)	35.8 (14.1)
23 ELBOW-FINGERTIP LENGTH	44.4 (17.5)	40.6 (16.0)	52.4 (20.6)	48.3 (19.0)
24 ELBOW REST HEIGHT	18.4 (7.2)	17.6 (6.9)	28.6 (11.3)	26.9 (10.6)
25 THIGH CLEARANCE HEIGHT	13.7 (5.4)	10.4 (4.1)	19.0 (7.5)	18.0 (7.1)
26 KNEE HEIGHT, SITTING	50.0 (19.7)	47.4 (18.7)	60.6 (23.9)	56.0 (22.0)
27 POPLITEAL HEIGHT	39.5 (15.6)	35.1 (13.8)	50.0 (19.7)	44.1 (17.4)
28 BUTTOCK-KNEE LENGTH	55.2 (21.7)	53.2 (20.9)	66.7 (26.3)	64.0 (25.2)
29 BUTTOCK-POPLITEAL LENGTH	45.6 (18.0)	43.5 (17.1)	54.6 (21.5)	52.8 (20.8)
31 FUNCTIONAL LEG LENGTH	100.2 (39.4)	93.3 (36.7)	116.9 (46.0)	109.4 (43.1)

TABLE XIV. SEATED BODY DIMENSIONS (continued)

B. ARMY PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
14 VERTICAL ARM REACH, SITTING	135.0 (53.1)	129.7 (51.1)	153.8 (60.6)	143.3 (56.4)
15 SITTING HEIGHT, ERECT	87.1 (34.3)	83.7 (33.0)	98.1 (38.6)	92.7 (36.5)
17 EYE HEIGHT SITTING, ERECT	75.3 (29.6)	72.2 (28.4)	86.1 (33.9)	81.2 (32.0)
19 MID-SHOULDER HEIGHT	59.7 (23.5)	57.0 (22.4)	68.5 (27.0)	64.5 (25.4)
20 SHOULDER HEIGHT, SITTING	56.4 (22.2)	54.1 (21.3)	65.6 (25.8)	61.9 (24.4)
21 SHOULDER-ELBOW LENGTH	34.3 (13.5)	33.0 (13.0)	40.0 (15.7)	36.8 (14.5)
22 ELBOW-GRIP LENGTH	33.3 (13.1)	31.6 (12.4)	38.5 (15.2)	35.5 (14.0)
23 ELBOW-FINGERTIP LENGTH	45.1 (17.8)	43.1 (17.0)	51.8 (20.4)	47.6 (18.7)
24 ELBOW REST HEIGHT	19.9 (7.8)	19.7 (7.8)	28.4 (11.2)	26.6 (10.5)
25 THIGH CLEARANCE HEIGHT	14.9 (5.9)	14.1 (5.6)	18.7 (7.4)	18.1 (7.1)
26 KNEE HEIGHT, SITTING	51.9 (20.4)	50.3 (19.8)	60.6 (23.9)	56.0 (22.0)
27 POPLITEAL HEIGHT	39.6 (15.6)	37.7 (14.8)	47.5 (18.7)	42.8 (16.9)
28 BUTTOCK-KNEE LENGTH	57.7 (22.7)	56.8 (22.4)	66.5 (26.2)	63.6 (25.0)
29 BUTTOCK-POPLITEAL LENGTH	46.3 (18.2)	46.3 (18.2)	55.0 (21.7)	52.3 (20.6)
31 FUNCTIONAL LEG LENGTH	100.9 (39.7)	99.1 (39.0)	117.1 (46.1)	109.8 (43.2)

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TABLE XIV. SEATED BODY DIMENSIONS (concluded)

C. AIR FORCE PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
15 SITTING HEIGHT, ERECT	88.1 (34.7)	86.6 (34.1)	98.6 (38.8)	90.9 (35.8)
16 SITTING HEIGHT, RELAXED		84.9 (33.4)		89.7 (35.9)
17 EYE HEIGHT SITTING, ERECT	76.2 (30.0)	73.5 (28.9)	86.1 (33.9)	80.2 (31.6)
19 MID-SHOULDER HEIGHT	60.2 (23.7)	57.5 (22.6)	69.2 (27.2)	63.7 (25.1)
20 SHOULDER HEIGHT, SITTING	56.5 (22.2)		65.9 (25.9)	
21 SHOULDER-ELBOW LENGTH	33.2 (13.1)		38.8 (15.3)	
22 ELBOW-GRIP LENGTH	32.6 (12.8)		37.9 (14.9)	
24 ELBOW REST HEIGHT	20.9 (8.2)	20.3 (8.0)	29.5 (11.6)	27.8 (10.9)
25 THIGH CLEARANCE HEIGHT	14.3 (5.6)	10.7 (4.2)	18.8 (7.4)	14.5 (5.7)
26 KNEE HEIGHT, SITTING	51.7 (20.4)		59.9 (23.6)	
27 POPLITEAL HEIGHT	40.1 (15.8)	39.9 (15.7)	47.5 (18.7)	45.2 (17.8)
28 BUTTOCK-KNEE LENGTH	56.1 (22.1)	55.7 (21.9)	65.0 (25.6)	62.5 (24.6)
29 BUTTOCK-POPLITEAL LENGTH	46.1 (18.1)	45.2 (17.8)	54.6 (21.5)	53.2 (20.9)

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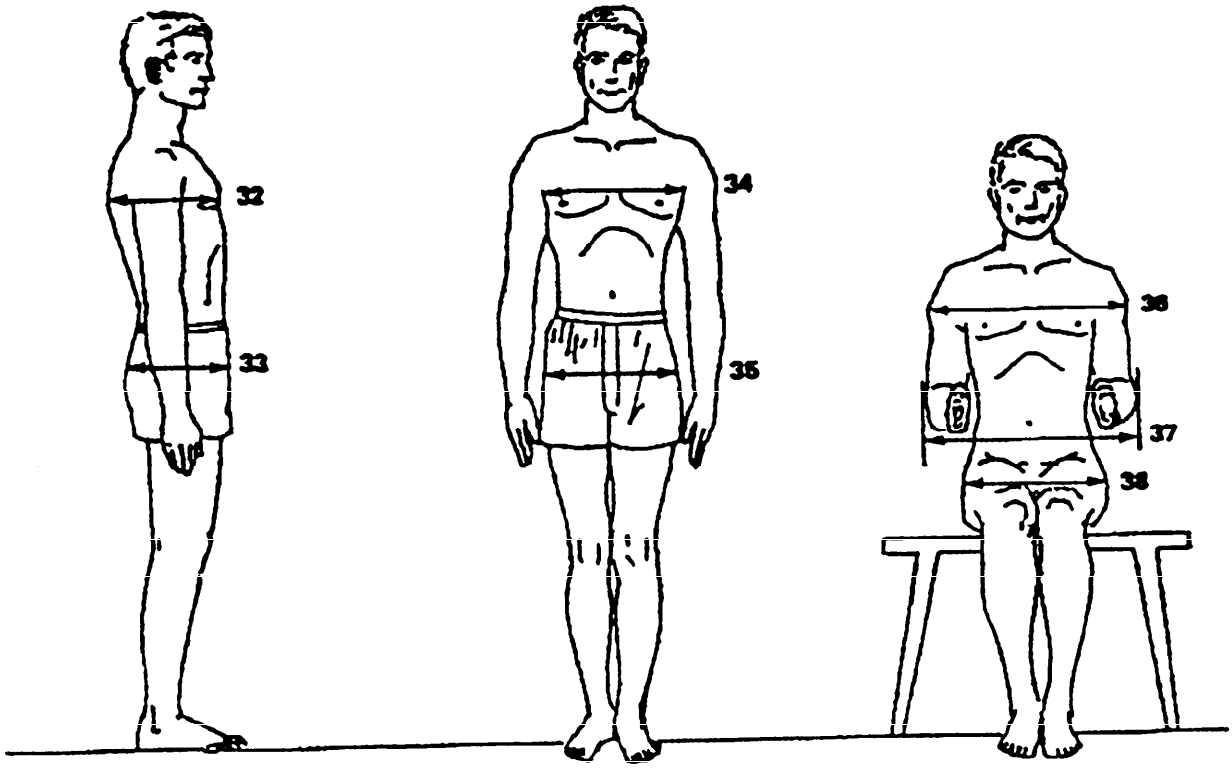

Dimension 39 — not used

FIGURE 25. Depth and Breadth Dimensions

TABLE XV. DEPTH AND BREADTH DIMENSIONS

A. GENERAL FORCES

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
32 CHEST DEPTH*	20.4 (8.0)	20.9 (8.2)	28.0 (11.0)	27.8 (10.9)
33 BUTTOCK DEPTH	21.2 (8.3)	18.4 (7.2)	28.6 (11.3)	26.5 (10.4)
34 CHEST BREADTH	27.8 (10.9)	25.0 (9.8)	36.7 (14.4)	31.5 (12.4)
35 HIP BREADTH, STANDING	30.5 (12.0)	30.8 (12.1)	38.3 (15.1)	38.8 (15.3)
36 SHOULDER (BIDELTOID) BREADTH	41.8 (16.5)	38.2 (15.0)	53.5 (21.1)	47.2 (18.6)
37 FOREARM-FOREARM BREADTH	47.7 (18.8)	41.5 (16.3)	62.1 (24.4)	52.8 (20.8)
38 HIP BREADTH, SITTING	31.1 (12.2)	33.8 (13.3)	41.3 (16.3)	43.3 (17.0)

B. ARMY PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
32 CHEST DEPTH*	21.7 (8.5)	20.7 (8.1)	28.4 (11.2)	28.2 (11.1)
33 BUTTOCK DEPTH	21.6 (8.5)	19.5 (7.7)	27.7 (10.9)	27.5 (10.8)
34 CHEST BREADTH	29.7 (11.7)	25.7 (10.1)	36.8 (14.5)	32.2 (12.7)
35 HIP BREADTH, STANDING	32.2 (12.7)	31.9 (12.6)	38.0 (15.0)	39.2 (15.4)
36 SHOULDER (BIDELTOID) BREADTH	46.0 (18.1)	40.3 (15.9)	53.4 (21.0)	47.6 (18.7)
37 FOREARM-FOREARM BREADTH	49.2 (19.4)	42.4 (16.7)	62.3 (24.5)	54.2 (21.3)
38 HIP BREADTH, SITTING	33.8 (13.3)	35.5 (14.0)	41.0 (16.1)	44.6 (17.6)

* Bust depth for women

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TABLE XV. DEPTH AND BREADTH DIMENSIONS (concluded)

C. AIR FORCE PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
32 CHEST DEPTH	21.3 (8.4)	20.9 (8.2)	27.7 (10.9)	26.1 (10.3)
33 BUTTOCK DEPTH	20.7 (8.1)	18.8 (7.4)	27.5 (10.8)	23.3 (9.2)
34 CHEST BREADTH	29.5 (11.6)	25.6 (10.1)	36.5 (14.4)	30.7 (12.1)
35 HIP BREADTH, STANDING	32.3 (12.7)	32.5 (12.8)	38.5 (15.2)	38.2 (15.0)
36 SHOULDER (BIDELTOID) BREADTH	44.1 (17.4)	38.8 (15.3)	52.6 (20.7)	45.0 (17.7)
37 FOREARM-FOREARM BREADTH	48.2 (19.0)		60.7 (23.9)	
38 HIP BREADTH, SITTING	34.2 (13.5)	34.5 (13.6)	41.8 (16.5)	41.9 (16.5)

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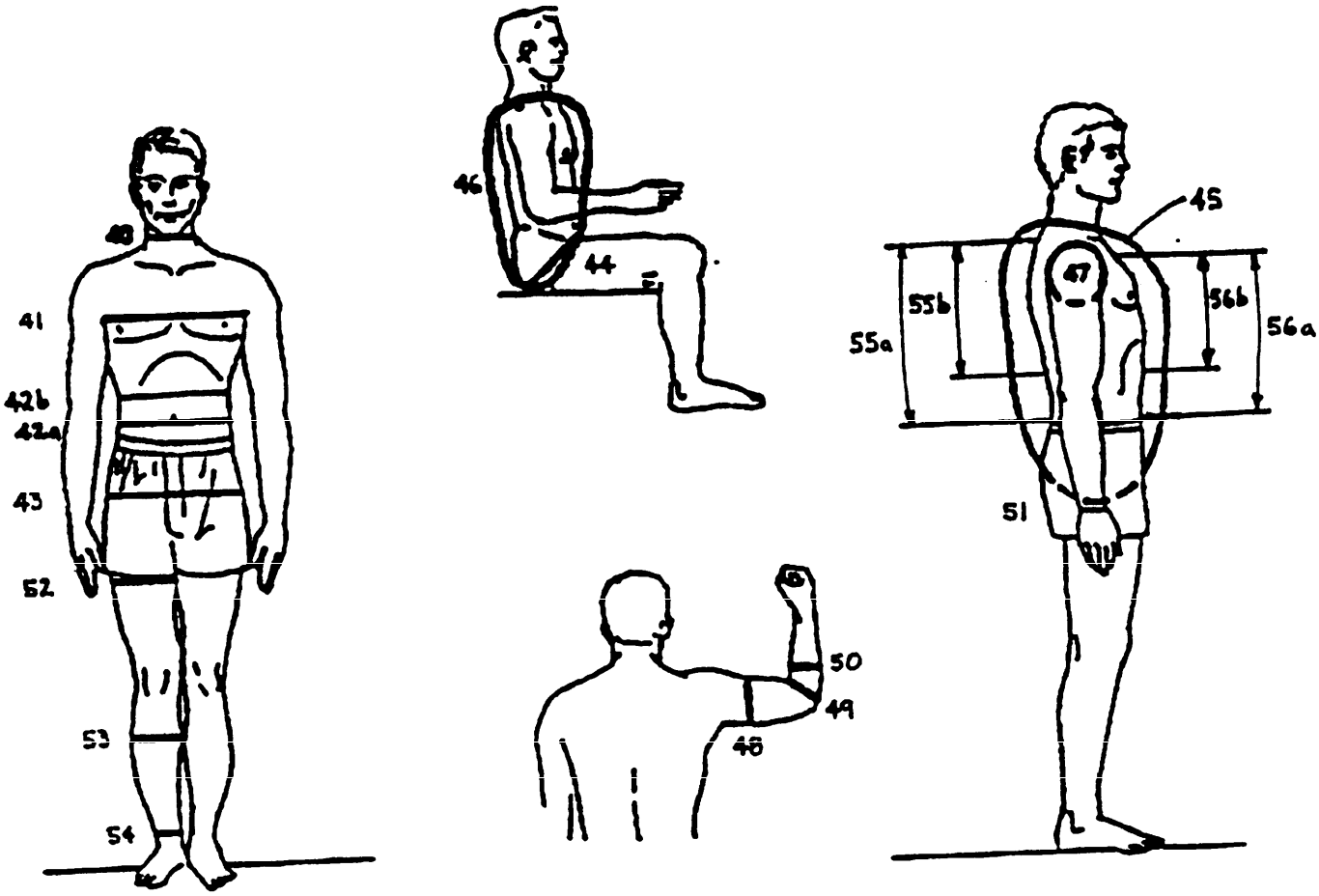

FIGURE 26. Circumferences and Surface Dimensions

TABLE XVI. CIRCUMFERENCES AND SURFACE DIMENSIONS

A. GENERAL FORCES

	Percentile Values in Centimeters (Inch Equivalents in Parentheses)			
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
40 NECK CIRCUMFERENCE	34.7 (13.7)	29.2 (11.5)	41.6 (16.4)	36.7 (14.4)
41 CHEST CIRCUMFERENCE*	85.5 (33.7)	81.4 (32.0)	111.3 (43.8)	102.2 (40.2)
42a WAIST CIRCUMFERENCE (OMPHALION)	70.2 (27.6)	67.6 (26.6)	101.6 (40.0)	94.6 (37.2)
42b WAIST CIRCUMFERENCE (NATURAL INDENTATION)	71.9 (28.3)	59.5 (23.4)	98.4 (38.7)	84.3 (33.2)
43 HIP (BUTTOCK) CIRCUMFERENCE, STANDING	86.7 (34.1)	85.8 (33.8)	109.0 (42.9)	107.0 (42.1)
45 VERTICAL TRUNK CIRCUMFERENCE, STANDING	150.6 (59.3)	142.0 (55.9)	180.7 (71.1)	166.3 (65.5)
47 ARM SCYE CIRCUMFERENCE	39.9 (15.7)	33.6 (13.2)	49.8 (19.6)	41.2 (16.2)
48 BICEPS CIRCUMFERENCE, FLEXED	27.7 (10.9)	23.3 (9.2)	38.5 (15.2)	32.1 (12.6)
49 ELBOW CIRCUMFERENCE, FLEXED	25.3 (10.0)	21.8 (8.6)	35.0 (13.8)	30.0 (11.8)
50 FOREARM CIRCUMFERENCE, FLEXED	26.5 (10.4)	23.0 (9.1)	33.6 (13.2)	27.9 (11.0)
51 WRIST CIRCUMFERENCE	15.7 (6.2)	13.8 (5.4)	18.8 (7.4)	16.3 (6.4)
52 UPPER THIGH CIRCUMFERENCE	49.1 (19.3)	48.7 (19.2)	67.9 (26.7)	65.7 (25.9)
53 CALF CIRCUMFERENCE	32.7 (12.9)	31.5 (12.4)	42.1 (16.6)	39.1 (15.4)
54 ANKLE CIRCUMFERENCE	20.0 (7.9)	18.6 (7.3)	25.0 (9.8)	23.3 (9.2)
55a WAIST (OMPHALION) - BACK LENGTH	43.5 (17.1)	40.4 (15.9)	52.3 (20.6)	48.5 (19.1)
55b WAIST (NATURAL INDENTATION) - BACK LENGTH	37.4 (14.7)	32.7 (12.9)	45.1 (17.8)	44.3 (17.4)
56a WAIST (OMPHALION) - FRONT LENGTH	35.9 (14.1)	35.5 (14.0)	45.7 (18.0)	42.8 (16.9)
56b WAIST (NATURAL INDENTATION) - FRONT LENGTH	31.0 (12.2)	27.5 (10.8)	38.1 (15.0)	36.9 (14.5)

*Bust circumference for women

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TABLE XVI. CIRCUMFERENCES AND SURFACE DIMENSIONS (continued)

B. ARMY PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
40 NECK CIRCUMFERENCE	35.2 (13.9)	29.3 (11.5)	41.2 (16.2)	34.5 (13.6)
41 CHEST CIRCUMFERENCE*	91.6 (36.1)	82.3 (32.4)	111.0 (43.7)	103.5 (40.7)
42a WAIST CIRCUMFERENCE (OMPHALION)	76.7 (30.2)	68.7 (27.0)	101.7 (40.0)	97.9 (38.5)
42b WAIST CIRCUMFERENCE (NATURAL INDENTATION)	75.3 (29.6)	64.7 (25.5)	96.7 (38.1)	87.6 (34.5)
43 HIP (BUTTOCK) CIRCUMFERENCE, STANDING	90.5 (35.6)	88.7 (34.9)	109.4 (43.1)	109.4 (43.1)
45 VERTICAL TRUNK CIRCUMFERENCE, STANDING	154.5 (60.8)	147.8 (58.2)	177.2 (69.8)	168.5 (66.3)
47 ARM SCYE CIRCUMFERENCE	40.8 (16.1)	34.5 (13.6)	48.5 (19.1)	42.2 (16.6)
48 BICEPS CIRCUMFERENCE, FLEXED	29.9 (11.8)	24.7 (9.7)	37.5 (14.8)	32.7 (12.9)
49 ELBOW CIRCUMFERENCE, FLEXED	25.4 (10.0)	22.3 (8.8)	30.1 (11.9)	26.5 (10.4)
50 FOREARM CIRCUMFERENCE, FLEXED	27.3 (10.7)	23.1 (9.1)	32.9 (13.0)	28.0 (11.0)
51 WRIST CIRCUMFERENCE	16.2 (6.4)	14.4 (5.7)	18.6 (7.3)	16.3 (6.4)
52 UPPER THIGH CIRCUMFERENCE	52.5 (20.7)	51.4 (20.2)	66.7 (26.3)	67.5 (26.6)
53 CALF CIRCUMFERENCE	34.2 (13.5)	32.0 (12.6)	41.6 (16.4)	39.6 (15.6)
54 ANKLE CIRCUMFERENCE	20.2 (8.0)	19.1 (7.5)	24.3 (9.6)	22.8 (9.0)
55a WAIST (OMPHALION) - BACK LENGTH	44.7 (17.6)	42.5 (16.7)	52.8 (20.8)	49.7 (19.6)
55b WAIST (NATURAL INDENTATION) - BACK LENGTH	38.7 (15.2)	34.8 (13.7)	45.7 (18.0)	42.2 (16.6)
56a WAIST (OMPHALION) - FRONT LENGTH	38.4 (15.1)	37.0 (14.6)	45.6 (18.0)	44.4 (17.5)
56b WAIST (NATURAL INDENTATION) - FRONT LENGTH	32.0 (12.6)	29.1 (11.5)	38.5 (15.2)	36.6 (14.4)

*Bust circumference for women

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TABLE XVI. CIRCUMFERENCES AND SURFACE DIMENSIONS (concluded)

C. AIR FORCE PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
40 NECK CIRCUMFERENCE	34.9 (13.7)	31.6 (12.4)	41.6 (16.4)	36.5 (14.4)
41 CHEST CIRCUMFERENCE*	88.6 (34.9)	82.7 (32.6)	109.4 (43.1)	96.1 (37.8)
42a WAIST CIRCUMFERENCE (OMPHALION)	75.7 (29.8)		100.1 (39.4)	
42b WAIST CIRCUMFERENCE (NATURAL INDENTATION)		60.8 (23.9)		73.0 (28.7)
43 HIP (BUTTOCK) CIRCUMFERENCE, STANDING	89.7 (35.3)	88.7 (34.9)	107.9 (42.5)	102.7 (40.4)
44 HIP (BUTTOCK) CIRCUMFERENCE, SITTING	97.1 (38.2)	93.9 (37.0)	119.3 (47.0)	107.4 (42.3)
45 VERTICAL TRUNK CIRCUMFERENCE, STANDING	156.7 (61.7)	150.6 (59.3)	180.2 (70.9)	166.0 (65.4)
46 VERTICAL TRUNK CIRCUMFERENCE, SITTING	150.4 (59.2)	147.6 (58.1)	173.2 (68.2)	161.8 (63.7)
47 ARM SCYE CIRCUMFERENCE	43.8 (17.2)	34.3 (13.5)	53.0 (20.9)	40.4 (15.9)
48 BICEPS CIRCUMFERENCE, FLEXED	29.1 (11.5)	23.6 (9.3)	36.6 (14.4)	29.1 (11.5)
49 ELBOW CIRCUMFERENCE, FLEXED	28.5 (11.2)	25.0 (9.8)	34.2 (13.5)	30.1 (11.9)
50 FOREARM CIRCUMFERENCE, FLEXED	27.2 (10.7)	23.0 (9.1)	32.4 (12.8)	27.1 (10.7)
51 WRIST CIRCUMFERENCE	16.2 (6.4)	14.2 (5.6)	19.2 (7.6)	16.3 (6.4)
52 UPPER THIGH CIRCUMFERENCE	51.5 (20.3)	49.5 (19.5)	66.2 (26.1)	60.8 (23.9)
53 CALF CIRCUMFERENCE	33.5 (13.2)	31.2 (12.3)	41.0 (16.1)	37.4 (14.7)
54 ANKLE CIRCUMFERENCE	20.4 (8.0)	19.7 (7.8)	24.6 (9.7)	23.5 (9.3)
55a WAIST (OMPHALION) - BACK LENGTH	43.1 (17.0)	39.3 (15.5)	50.9 (20.0)	45.4 (17.9)
56a WAIST (OMPHALION) - FRONT LENGTH	36.9 (14.5)	31.6 (12.4)	44.2 (17.4)	37.7 (14.8)

*Bust circumference for women

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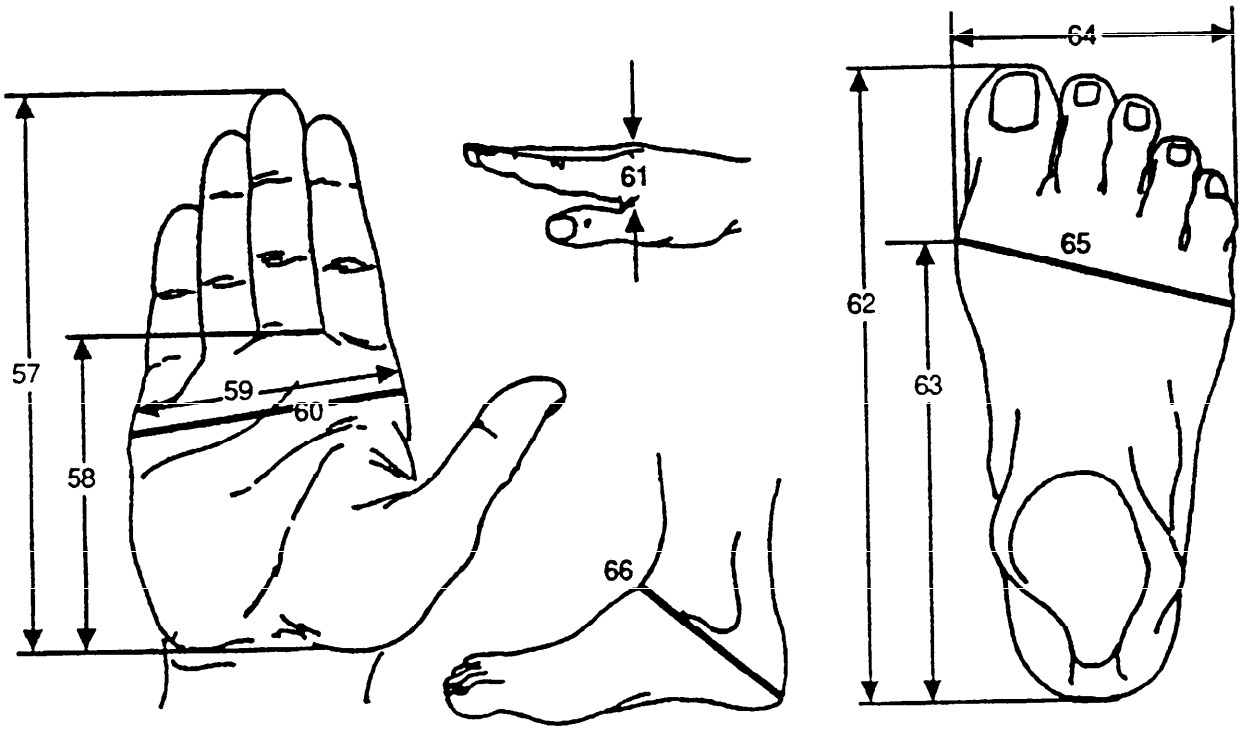

FIGURE 27. Hand and Foot Dimensions

TABLE XVII. HAND AND FOOT DIMENSIONS

A. GENERAL FORCES

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
57 HAND LENGTH	17.5 (6.9)	16.5 (6.5)	21.1 (8.3)	20.1 (7.9)
58 PALM LENGTH*	9.6 (3.8)	9.0 (3.5)	11.7 (4.6)	10.8 (4.3)
59 HAND BREADTH	8.2 (3.2)	6.9 (2.7)	9.8 (3.9)	8.6 (3.4)
60 HAND CIRCUMFERENCE	19.9 (7.8)	16.8 (6.6)	23.5 (9.3)	20.0 (7.9)
62 FOOT LENGTH	24.6 (9.7)	22.2 (8.7)	29.2 (11.5)	26.5 (10.4)
63 INSTEP LENGTH	17.9 (7.0)	16.4 (6.5)	21.4 (8.4)	19.5 (7.7)
64 FOOT BREADTH	9.0 (3.5)	8.0 (3.1)	11.0 (4.3)	9.8 (3.9)
65 FOOT CIRCUMFERENCE	22.9 (9.0)	20.5 (8.1)	27.3 (10.7)	24.2 (9.5)
66 HEEL-ANKLE CIRCUMFERENCE	31.3 (12.3)	28.1 (11.1)	36.9 (14.5)	33.0 (13.0)

* Data for males were compiled from the 1966 survey of U.S. Army Men, the 1966 survey of U.S. Marines, and the 1965 survey of U.S. Air Force Men. Data for females were complied from the 1977 survey of U.S. Army Women and the 1968 survey of U.S. Air Force Women.

B. ARMY PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
57 HAND LENGTH	18.1 (7.1)	17.2 (6.8)	20.9 (8.2)	19.5 (7.7)
59 HAND BREADTH	8.4 (3.3)	7.5 (3.0)	9.7 (3.8)	8.6 (3.4)
60 HAND CIRCUMFERENCE	19.9 (7.8)	17.6 (6.9)	22.8 (9.0)	20.1 (7.9)
62 FOOT LENGTH	25.0 (9.8)	23.2 (9.1)	28.9 (11.4)	26.5 (10.4)
63 INSTEP LENGTH	18.2 (7.2)	17.0 (6.7)	21.4 (8.4)	19.6 (7.7)
64 FOOT BREADTH	9.2 (3.6)	8.4 (3.3)	10.8 (4.3)	9.8 (3.9)
65 FOOT CIRCUMFERENCE	23.1 (9.1)	21.0 (8.3)	26.9 (10.6)	24.4 (9.6)
66 HEEL-ANKLE CIRCUMFERENCE	31.3 (12.3)	28.9 (11.4)	36.4 (14.3)	32.7 (12.9)

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TABLE XVII. HAND AND FOOT DIMENSIONS (concluded)

C. AIR FORCE PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
57 HAND LENGTH	17.8 (7.0)	17.6 (6.9)	20.5 (8.1)	20.4 (8.0)
58 PALM LENGTH	10.0 (3.9)		11.8 (4.6)	
59 HAND BREADTH	8.2 (3.2)	7.1 (2.8)	9.6 (3.8)	8.3 (3.3)
60 HAND CIRCUMFERENCE	20.0 (7.9)	17.2 (6.8)	23.1 (9.1)	19.9 (7.8)
61 HAND THICKNESS	2.4 (0.9)		3.1 (1.2)	
62 FOOT LENGTH	25.1 (9.9)	23.2 (9.1)	29.0 (11.4)	26.3 (10.4)
63 INSTEP LENGTH	18.3 (7.2)		21.4 (8.4)	
64 FOOT BREADTH	9.0 (3.5)	8.2 (3.2)	10.6 (4.2)	9.9 (3.9)
65 FOOT CIRCUMFERENCE	22.9 (9.0)		27.0 (10.6)	
66 HEEL-ANKLE CIRCUMFERENCE	31.7 (12.5)		36.3 (14.3)	

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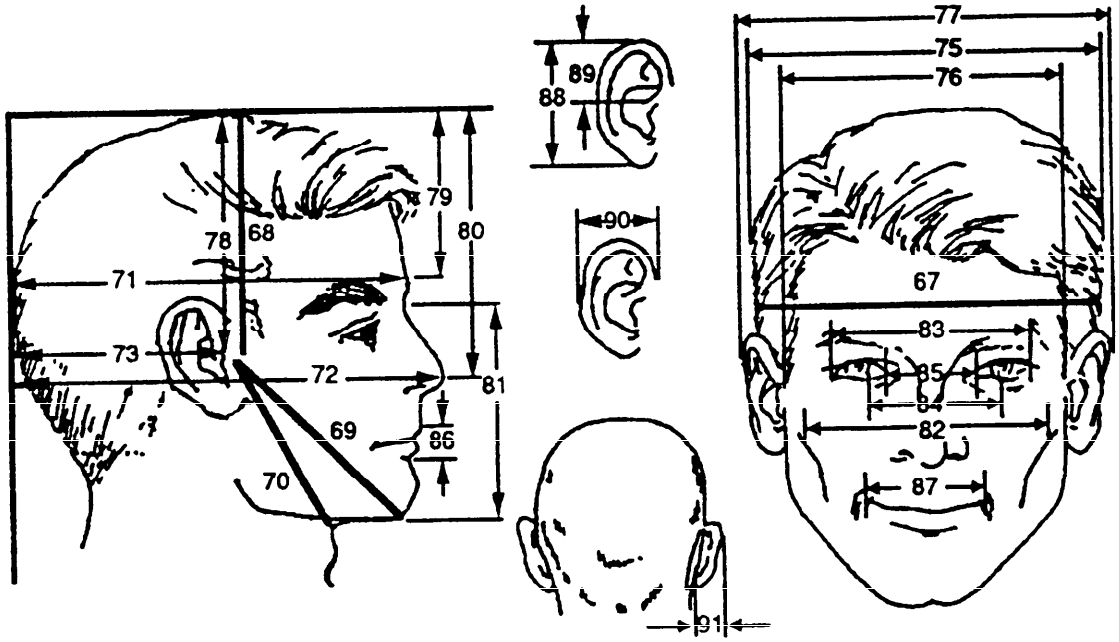

FIGURE 28. Head and face dimensions

TABLE XVIII. HEAD AND FACE DIMENSIONS

A. GENERAL FORCES

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
67 HEAD CIRCUMFERENCE	53.6 (21.1)	52.3 (20.6)	59.7 (23.5)	57.6 (22.7)
68 BITRAGION-CORONAL CURVATURE	33.2 (13.1)	31.6 (12.4)	38.0 (15.0)	36.3 (14.3)
69 BITRAGION-MENTON CURVATURE	30.4 (12.0)	28.2 (11.1)	34.8 (13.7)	32.6 (12.8)
70 BITRAGION-SUBMANDIBULAR CURVATURE	27.8 (10.9)	25.6 (10.1)	33.0 (13.0)	29.7 (11.7)
71 HEAD LENGTH	18.3 (7.2)	17.3 (6.8)	21.0 (8.3)	19.8 (7.8)
72 PRONASALE TO WALL	20.5 (8.1)	19.7 (7.8)	23.6 (9.3)	22.9 (9.0)
73 TRAGION TO WALL	8.6 (3.4)	8.6 (3.4)	12.6 (5.0)	11.8 (4.6)
75 HEAD BREADTH	14.3 (5.6)	13.5 (5.3)	16.5 (6.5)	15.5 (6.1)
76 BITRAGION BREADTH	12.6 (5.0)	12.1 (4.8)	15.5 (6.1)	14.5 (5.7)
77 BIAURICULAR BREADTH	17.4 (6.9)	14.2 (5.6)	21.0 (8.3)	19.5 (7.7)
78 HEAD HEIGHT (TRAGION TO TOP OF HEAD)	12.1 (4.8)	11.3 (4.4)	14.5 (5.7)	14.1 (5.6)
79 GLABELLA TO TOP OF HEAD	7.6 (3.3)	7.7 (3.0)	10.8 (4.3)	10.0 (3.9)
80 PRONASALE TO TOP OF HEAD	13.8 (5.4)	12.8 (5.0)	16.6 (6.5)	16.8 (6.6)
81 FACE LENGTH (MENTON-SELLION)	10.7 (4.2)	9.6 (3.8)	13.3 (5.2)	12.4 (4.9)
82 FACE (BIZYGOMATIC) BREADTH	13.1 (5.2)	11.9 (4.7)	15.0 (5.9)	14.0 (5.5)
83 BIOCULAR BREADTH	11.3 (4.4)	11.1 (4.4)	13.1 (5.2)	12.9 (5.1)
84 INTERPUPILLARY BREADTH	5.4 (2.1)	5.1 (2.0)	7.1 (2.8)	6.9 (2.7)
87 LIP LENGTH (MOUTH BREADTH)	4.4 (1.7)	3.7 (1.5)	6.3 (2.5)	6.2 (2.4)
89 EAR LENGTH ABOVE TRAGION	2.5 (1.0)	2.5 (1.0)	3.6 (1.4)	3.3 (1.3)
90 EAR BREADTH	3.2 (1.3)	2.4 (0.9)	4.2 (1.7)	3.9 (1.5)
91 EAR PROTRUSION	1.7 (0.7)	1.7 (0.7)	3.0 (1.2)	2.7 (1.1)

TABLE XVIII. HEAD AND FACE DIMENSIONS (continued)

B. ARMY PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
67 HEAD CIRCUMFERENCE	54.8 (21.6)	52.6 (20.7)	59.2 (23.3)	56.8 (22.4)
68 BITRAGION-CORONAL CURVATURE	33.3 (13.1)	31.7 (12.5)	37.3 (14.7)	35.8 (14.1)
69 BITRAGION-MENTON CURVATURE	31.0 (12.2)	28.3 (11.1)	34.9 (13.7)	32.0 (12.6)
70 BITRAGION-SUBMANDIBULAR CURVATURE	28.8 (11.3)	25.8 (10.2)	33.1 (13.0)	29.9 (11.8)
71 HEAD LENGTH	18.8 (7.4)	17.6 (6.9)	20.9 (8.2)	19.8 (7.8)
72 PRONASALE TO WALL	20.9 (8.2)	19.9 (7.8)	23.2 (9.1)	22.3 (8.8)
73 TRAGION TO WALL	9.1 (3.6)	8.8 (3.5)	10.8 (4.3)	10.6 (4.2)
75 HEAD BREADTH	14.5 (5.7)	13.8 (5.4)	16.3 (6.4)	15.3 (6.0)
76 BITRAGION BREADTH	13.5 (5.3)	12.8 (5.0)	15.4 (6.1)	14.5 (5.7)
77 BIAURICULAR BREADTH	17.9 (7.0)	16.7 (6.6)	21.1 (8.3)	19.7 (7.8)
78 HEAD HEIGHT (TRAGION TO TOP OF HEAD)	12.1 (4.8)	11.6 (4.6)	13.9 (5.5)	13.5 (5.3)
79 GLABELLA TO TOP OF HEAD	8.6 (3.4)	7.8 (3.1)	10.8 (4.3)	10.1 (4.0)
80 PRONASALE TO TOP OF HEAD	14.0 (5.5)	13.1 (5.2)	16.5 (6.5)	15.8 (6.2)
81 FACE LENGTH (MENTON-SELLION)	11.2 (4.4)	10.5 (4.1)	13.2 (5.2)	12.5 (4.9)
82 FACE (BIZYGOMATIC) BREADTH	13.3 (5.2)	12.3 (4.8)	15.1 (5.9)	14.0 (5.5)
83 BIOCULAR BREADTH	11.4 (4.5)	11.0 (4.3)	13.0 (5.1)	12.7 (5.0)
84 INTERPUPILLARY BREADTH	5.9 (2.3)	5.6 (2.2)	7.0 (2.8)	6.6 (2.6)
87 LIP LENGTH (MOUTH BREADTH)	5.1 (2.0)	4.8 (1.9)	6.3 (2.5)	6.0 (2.4)
89 EAR LENGTH ABOVE TRAGION	2.8 (1.1)	2.6 (1.0)	3.6 (1.4)	3.3 (1.3)
90 EAR BREADTH	3.4 (1.3)	3.1 (1.2)	4.2 (1.7)	3.9 (1.5)
91 EAR PROTRUSION	2.0 (0.8)	1.7 (0.7)	3.0 (1.2)	2.8 (1.1)

TABLE XVIII. HEAD AND FACE DIMENSIONS (concluded)

C. AIR FORCE PILOTS

Percentile Values in Centimeters (Inch Equivalents in Parentheses)				
	5th Percentile		95th Percentile	
	Male	Female	Male	Female
67 HEAD CIRCUMFERENCE	55.2 (21.7)	52.9 (20.8)	59.9 (23.6)	57.9 (22.8)
68 BITRAGION-CORONAL CURVATURE	33.7 (13.3)	32.0 (12.6)	37.9 (14.9)	36.7 (14.4)
69 BITRAGION-MENTON CURVATURE	30.6 (12.0)		34.7 (13.7)	
70 BITRAGION-SUBMANDIBULAR CURVATURE	28.4 (11.2)		33.6 (13.2)	
71 HEAD LENGTH	18.8 (7.4)	17.5 (6.9)	21.0 (8.3)	19.7 (7.8)
72 PRONASALE TO WALL	21.4 (8.4)	20.0 (7.9)	23.9 (9.4)	23.0 (9.1)
73 TRAGION TO WALL	9.3 (3.7)	9.0 (3.5)	11.4 (4.5)	11.9 (4.7)
75 HEAD BREADTH	14.7 (5.8)	13.6 (5.4)	16.5 (6.5)	15.5 (6.1)
76 BITRAGION BREADTH	13.4 (5.3)	12.2 (4.8)	15.2 (6.0)	13.8 (5.4)
77 BIAURICULAR BREADTH	17.5 (6.9)	14.4 (5.7)	20.2 (8.0)	17.5 (6.9)
78 HEAD HEIGHT (TRAGION TO TOP OF HEAD)	12.4 (4.9)	11.7 (4.6)	14.5 (5.7)	14.2 (5.6)
79 GLABELLA TO TOP OF HEAD	7.7 (3.0)		10.9 (4.3)	
80 PRONASALE TO TOP OF HEAD	13.0 (5.1)	13.3 (5.2)	16.6 (6.5)	17.1 (6.7)
81 FACE LENGTH (MENTON-SELLION)	11.0 (4.3)	9.8 (3.9)	13.0 (5.1)	11.8 (4.6)
82 FACE (BIZYGOMATIC) BREADTH	13.4 (5.3)	12.0 (4.7)	15.1 (5.9)	13.8 (5.4)
83 BIOCULAR BREADTH	8.4 (3.3)	9.0 (3.5)	10.0 (3.9)	10.6 (4.2)
84 INTERPUPILLARY BREADTH	5.7 (2.2)		6.9 (2.7)	
85 INTEROCULAR BREADTH	2.9 (1.1)		3.3 (1.3)	
86 LIP TO LIP LENGTH	1.1 (0.4)		2.3 (0.9)	
87 LIP LENGTH (MOUTH BREADTH)	4.6 (1.8)	3.7 (1.5)	5.8 (2.3)	5.1 (2.0)
88 EAR LENGTH	5.9 (2.3)	4.5 (1.8)	7.3 (2.9)	5.9 (2.3)
89 EAR LENGTH ABOVE TRAGION	2.5 (1.0)		3.5 (1.4)	
90 EAR BREADTH	3.3 (1.3)	2.4 (0.9)	4.3 (1.7)	3.5 (1.4)
91 EAR PROTRUSION	1.7 (0.7)		2.8 (1.1)	

5.6.3 Use of Data.

5.6.3.1 Data limitations. Because the anthropometric data presented here represent nude body measurements, suitable allowances shall be made for light or heavy clothing, flying suits, helmets, boots, body armor, load-carrying equipment, protective equipment, and other worn or carried items, when utilizing these data for design criteria.

5.6.3.2 Clearance dimensions. Clearance dimensions (e.g., for passageways and accesses), which must accommodate or allow passage of the body or parts of the body, shall be based upon the 95th percentile values for applicable body dimensions.

5.6.3.3 Limiting dimensions. Limiting dimensions (reaching distance, control movement, displays, test points, handrails, etc.) which restrict or are limited by extensions of the body shall be based upon the 5th percentile values for applicable body dimensions.

5.6.3.4 Adjustable dimensions. Seats, restraint systems, safety harnesses, belts, controls or any equipment that must be adjusted for the comfort or performance of the individual user shall be adjustable over the range of the 5th to 95th percentile values for the applicable body member(s).

5.6.3.5 Clothing and personal equipment. Clothing and personal equipment (including protective or specialized equipment worn or carried by the individual) shall be designed and sized to accommodate at least the 5th through the 95th percentile values of body dimensions. Pertinent dimensions of essential or critical equipment (e.g., aviators' helmets) shall be based on the lst and 99th percentile values. Where two or more dimensions are used simultaneously as design parameters, appropriate multivariate data and techniques shall be utilized. (See appendix for representative references.)

5.6.4 Special populations. Where equipment will be used, inclusively or exclusively, by selected or specialized segments of the military population (e.g., Army tank crews, Navy divers, etc.) or population ranges other than the 5 - 95th percentiles (e.g., disproportionate anthropometric accommodation test cases), appropriate available anthropometric data on these specialized populations, contained in DOD-HDBK-743, shall be utilized for design and sizing criteria. Where equipment is intended for use by foreign military personnel, appropriate anthropometric data on such populations shall be utilized for design and sizing criteria. (See appendix for representative references.)

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5.11 Small systems and equipment.

5.11.1 Portability and load carrying. Individual portions of equipment shall be designed so that, when carried, the weight of the load will be distributed through as many muscle groups as possible. Pressure should be avoided or minimized on sensitive areas, including large blood vessels, nerves and areas lacking muscular padding. Design of load-carrying systems shall consider the weight and distribution of individual items to be carried by the user. The weight of the items to be carried varies according to the climatic zone, mission to be performed, and occupational specialty. See Table XXVI for weights of representative individual items that an infantry rifleman carries in temperate hot weather areas. Load carrying systems shall be provided with a quick-release capability. In general, portable refers to an item that is carried a distance of no more than 2 km (1.24 miles). For items to be carried up to 10 meters (33 ft.), see paragraphs 5.9.11.3.5, 5.9.11.3.6, and 5.9.11.3.7.

5.11.1.1 Portability.

5.11.1.1.1 Weight. Individual portions of equipment may weigh up to 16 kg (35 lb) if the load is balanced and is distributed over many muscle groups and it is not necessary for the individual carrying the load to maintain the pace of an infantry movement.

5.11.1.1.2 Lifting aids. When necessary, lifting aids shall be provided to permit a second person to assist the porter in placing the load on the body.

5.11.1.1.3 Configuration. The load should be designed to permit freedom of movement. The shape of the load should be free of sharp edges or projections that may be harmful to the porter or snag on undergrowth. The shape and weight of the load should not interfere with:

a. The length of step.

b. Movements of the head.

c. The ability to raise and lower the load when going over obstacles.

d. The ability to see where the feet are placed when walking.

e. The ability to squat.

f. Regulation of body temperature.

g. The maintenance of normal posture.

5.11.1.1.4 Carrying by two persons. Where the load is designed for carrying by two persons, a combination of stretcher type handles and shoulder support should be used, if feasible.

5.11.1.1.5 Standardization. Maximum use should be made of standard load carrying systems or components.

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TABLE XXVIII. TYPICAL FIGHTING AND EXISTENCE LOADS (TEMPERATE ZONE)

LOAD	APPROXIMATE WEIGHT KILOGRAMS	POUNDS
FIGHTING LOAD		
CLOTHING:		
PASGT Helmet	1.36	3.00
Battle Dress Uniform	1.73	3.81
PASGT Vest	3.86	8.50
Underwear (Summer) and Socks	0.27	0.60
Belt; waist, web w/buckle	0.09	0.20
Boots, leather (DMS)	1.52	3.36
	8.83	19.47
EQUIPMENT:		
Rifle M16A1 w/30 rd magazine and sling	3.59	7.91
Ammunition pouches (2 ea) w/180 rounds in 6 magazines	3.21	7.07
Hand grenades 2 ea	0.91	2.00
LAW 2 ea or ILAW 1 ea	3.86	8.50
Canteen 1 qt. filled w/cup and cover	1.63	3.60
Water purification tablets	0.03	0.06
Individual equipment belt, first aid packet w/case and suspenders	0.72	1.59
Intrenching tool w/carrier	1.14	2.52
Bayonet M7 w/scabard	0.59	1.30
Mask CB Protective w/hood	1.35	2.97
Poncho	0.77	1.70
	17.80	39.22
EXISTENCE LOAD:		
ALICE Pack medium w/straps	1.12	2.46
Chemical Protective overgarment w/gloves and boots	2.61	5.75
Cap, utility	0.10	0.22
Underwear and socks, 2 ea	0.54	1.20
Personal Hygiene Kit	1.20	2.64
Rations MRE 3 ea	1.33	2.94
Bag, Sleeping, intermediate cold	3.40	7.50
Mattress, pneumatic insulated	1.59	3.50
Jacket Field, 1 ea w/gloves, leather w/wool insert 1 pr	1.94	4.28
Bag, waterproof 1 ea	0.34	0.75
	14.17	31.24

5.13.7.3.2 Fluid and fuel servicing equipment. Automatic shutoff devices shall be provided on fluid and fuel service equipment to prevent overflow and spillage.

5.13.7.4 Toxic hazards.

5.13.7.4.1 General. Personnel shall not be exposed to the concentrations of toxic substances in excess of the limits specified in either the Department of Defense (DoD) Occupational Safety and Health (OSH) standards or specialized standards applicable to military unique equipment, systems or operations.

5.13.7.4.2 Carbon monoxide. Carbon monoxide in personnel areas shall be reduced to the lowest level feasible. Personnel shall not be exposed to concentrations of carbon monoxide (CO) in excess of values which will result in carboxyhemoglobin (COHb) levels in their blood greater than the following percentages: 5% COHb (all system design objectives and aviation system performance limits); 10% COHb (all other system performance limits). It is acceptable to estimate COHb blood levels in personnel by solving the empirical equation given in paragraph 3.7.5 of MIL-HDBK-759A. When using the equations to estimate the percent COHb blood levels for combat vehicle occupants, the following work stress levels (defined by MIL-HDBK-759A) shall be applied as appropriate: activities involving weapons fire - level 4; all other mission activities - level 3. An initial value of COHbo=1.0% shall be assumed for all estimates.

5.13.7.5 Radiation. Radiation emitting systems and equipment require special consideration to minimize hazards to operators and maintenance personnel. Ionizing radiation exposure rates produced by any device shall not exceed 0.5 milliroentgens/hr at a distance of 50 mm (2") from any point on the external surface. Microwave, radio frequency, X and laser radiation limits shall conform to those specified in Requirement 1, MIL-STD-454. Definitive and specific data should be obtained from the service agency responsible for control of personnel exposure to radiation.

5.13.7.5 Trainers. Training materials, devices, simulators and other systems utilizing embedded training, should incorporate appropriate safety safeguards, warnings and other procedures developed during the material design process.

5.13.9 Stealth and covert operations. Systems and equipment designed for use in combat may require stealth for covert operations. The need for low-observable exterior and camouflage may preclude the use of brightly colored warning signs, warning lights and/or auditory alarms. For such systems and equipment, emphasis must be placed on barriers, interlocks and other techniques which insure safe operations.

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10 SCOPE

The documents listed in this appendix provide supplementary information, criteria and guidance that may be used, as applicable, to assist the designer in complying with the requirements of this standard. Their application is not to be regarded as mandatory, unless so specified by the procuring activity.

20 TRI-SERVICE PUBLICATIONS

MIL-HDBK-761 Systems	Human Engineering Guidelines for Management Information
DOD-HDBK-763	Human Engineering Procedures Guide
MIL-H-46855	Human Engineering Requirements for Military Systems, Equipment, and Facilities
MIL-HDBK-141	Optical Design
TB MED 81 NAVMED P-5052-29 AFR 161-11	Cold Injury
CSC-STD-002-85	Department of Defense Password Management Guide (Fort George G. Meade, MD: Department of Defense Security Center.)
MIL-STD-1474	Noise Limits for Military Materiel

30 ARMY PUBLICATIONS

30.1 Regulations

AR 40-10	Health Hazard Assessment Program in Support of the Army Materiel Acquisition Decision Process
AR 40-14	Control and Recording Procedures, Occupational Exposure to Ionizing Radiation
AR 385-16	Safety for Systems, Associated Subsystems and Equipment
AR 700-52	Licensing and Control of Sources of Ionizing Radiation

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30.2 Pamphlets & Bulletins

AMCP 706-134	Maintainability Guide for Design (AD 823 539)
DA PAM 40-501	Hearing Conservation
TB MED 521	Diagnostic X-Ray, Therapeutic X-Ray, and Gamma Beam Protection for Energies up to 10 Million Electron Volts
TB MED 270	Control of Hazards to Health from Microwave Radiation
TB MED 279	Control of Hazards to Health from Laser Radiation
TB MED 288	Medical Problems of Man at High Terrestrial Elevations
TB MED 508	Cold Injury

30.3 Design Criteria Handbook

MIL-HDBK-759	Human Factors Engineering Design for Army Materiel
DOD-HDBK-743	Military Handbook, Anthropometry of U.S. Military Personnel
DOD-HDBK-761	Human Engineering Guide for Management Information Systems

30.4 Reports

AVSCOM Rept 75-47	Study to Determine the Impact of Aircrew Anthropometry on Airframe Configuration
Natick Laboratories TR EPT-2	Reference Anthropometry of the Arctic Equipped Soldier (AD 449 4831)
Natick Laboratories TR 73-51-CE	The Carrying of Loads within an Infantry Company (AD 762 559)
Natick RDEC TR 89/040	1988 Anthropometric Survey of U.S. Army Personnel Methods and Summary Statistics (AD A225094)
USAAMRDL TR 71-22	Crash Survival Design Guide (Revised 1971)
USAHEL TM 4-77	A Human Factors Evaluation of a Vertical Scale Instrument Display System for the OV-1D Aircraft (AD A03 6050)

40 NAVY PUBLICATIONS

40.1 Manual

NAVAIR 00-807-99	U.S. Naval Aerospace Physiologist's Manual, 1972

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40.2 Reports

NATC Rept TM 77-1 SY	Analysis of Flight Clothing Effects on Aircrew Station Geometry (AD AO46260)
NAMRL Report 1164	Empirical Reduction in Potential user Population as the Result of Imposed Multivariate Anthropometry Limits (AD 752 032)
NAVMISCEN Report TP-74-6	Reduction in Potential user Population as the Result of Imposed Anthropometry Limits: Monte Carlo Estimation (AD 919 319L)
NAVSHIPS 94323	Human Engineering Guidelines for Maintainability
NEL Report 688	Listening to Differentially Filtered Competing Voice Messages
NRL Report 155	Premodulation Speech Clipping and Filtering: Their Effects on the Intelligibility of Speech
PACMISTESTCEN Report TM-75-46	The Accommodated Population of a Potential User Population: Compilation and Comparisons of Methods for Estimation
PACMISTESTCEN Report TP-75-49	Computerized Accommodated Percentage (CAPE) Model for Cockpit Analysis and other Exclusion Studies (AD B008 948L)
PACMISTESTCEN Report TP-76-1	Improved Seat, Console and Workplace Design (AD AO40 479)
PACMISTESTCEN Report TP-76-36	Recommended Human Exposure Limits for Very-Low-Frequency Vibration
PACMISTESTCEN Report TP-76-46	Computerized Accommodated Percentage (CAPE): Review and Prospectus (AD AO35 205)

40.3 Notes

NAVMEDNOTE 6260	Hazardous Noise Areas, Equipment, Machine and Tools; Identification of

50 AIR FORCE PUBLICATIONS

50.1 Manuals

AFM 127-201	Missile Safety Handbook
AFP 160-6-7	Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radio-Nuclides in Air and Water for Occupational Exposure

50.2 Reports

AFFDL-TDR-64-86	Investigation of Aerospace Vehicle Crew Station Criteria (AD 452 187)
AFSWC TR 59-11	Human Factors Handbook for Design of Transporting, Positioning, and Lifting Ground Support Equipment (AD 227 311)
AFSWC TR 59-12	Human Factors Handbook for Design of Testing and Monitoring Ground Support Equipment (AD 227 312)
AFSWC TR 59-13	Human Factors Handbook for Design of Protective and Storage Ground Support Equipment (AD 227 313)
AMRL TDR 64-59	Reach Capability of the USAF Population (AD 608269)
AMRL TR 65-73	Anthropometry of Common Working Positions (AD 632 241)
AMRL TR 66-27	Aperture Sizes and Depths of Reach for One and Two-Handed Tasks (AD 646 716)
AMRL TR 68-24	Clearance and Performance Values for the Bare-Handed and the Pressure-Gloved (AD 681 457)
AMRL TR 69-6	Anthropometric Dimensions of Air Force Pressure-Suited Personnel for Workspace and Design Criteria (AD 697 022)
AMRL TR 70-114	Horizontal Static Forces Exerted by Men Standing in Common Working Positions on Surfaces of Various Tractions (AD 720 252)
ASD TR 54-520	The Anthropometry of Work Positions (AD 110 573)
ASD TR 56-218	Guide to the Design of Electronic Equipment for Maintainability (AD 101 729)
ASD TN 57-248	Acoustical Criteria for Work Spaces, Living Quarters, and Other Areas on Air Bases (AD 130 839)
ASD TR 61-381	Guide to the Design of Mechanical Equipment for Maintainability (AD 269 332)
ASD TR 61-424	Guide to Integrated System Design for Maintainability (AD 271 477)
ESD TDR 62-4	A Test of the 20 Band and Octave Band Methods of Computing the Articulation Index (AD 271 606)

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ESD-TR-63-403	Psychoacoustic Speech Test: A Modified Rhyme Test (AD 411 983)
ESD TR 86-278	Guidelines for Designing User Interface Software (AD-A 177 198)
RADC-TDR-62-315	Criteria for Group Display Chains for The 1962-1965 Time Period (AD 283 390)
WADC TR 52-204	Handbook of Acoustic Noise Control (AD 018 260 and AD 012 015)
WADC TR 55-159	Space Requirements of the Seated Operator (AD 087 892)
WADC TR 58-474	The Effect of Team Size and Intermember Communication on decision-Making Performance (AD 215 621)
WADD TR 60-814	Audio Warning Signals for Air Force Weapon Systems (AD 258 477)

50.3 Air Force Systems Command Design Handbooks

Copies of Air Force Systems Command design criteria handbooks may be obtained by nongovernmental organizations when compliance therewith is required by a Government contract, or when possession of the handbook will otherwise benefit the Government. Requests for the following handbooks should be directed to 4950/TZHM, Wright-Patterson AFB, OH 45433:

AFSC DH 1-1	General Index and Reference
AFSC DH 1-3	Human Factors Engineering
AFSC DH 1-6	System Safety
AFSC DH 2-1	Airframe
AFSC DH 2-2	Crew Stations and Passenger Accommodations
AFSC DH 2-3	Propulsion and Power
AFSC DH 2-6	Ground Equipment and Facilities

60 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION PUBLICATIONS

60.1 Standards

Copies of the following documents can be obtained by qualified requesters from MSIS Custodian/SP34, NASA-Johnson Space Center, Houston, TX 77058

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NASA-STD-3000, Volume I Man-Systems Integration Standards

NASA-STD-3000, Volume II Man-Systems Integration Standards-Appendices

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60.2 Book

Copies of the following documents can be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20402

NASA SP-3006	Bioastronautics Data Book, Second Edition, J.F. Parker and V.R. West, eds.

70 VOLUNTARY STANDARDS AND GUIDES

70.1 American National Standards Institute (ANSI)

Copies of the following standards can be obtained at a nominal cost from the ANSI, 1440 Broadway, New York, New York 10018.

ANSI A12.1	Floor and Wall Openings, Railings, and Toeboards, Safety Requirements for
ANSI A14.3	Ladders-Fixed-Safety Requirements
ANSI C2	national Electrical Safety Code (NBS H30)
ANSI S1.11	Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters (ASA 65)
ANSI Z136.1	Safe use of Lasers

70.2 American Society for Testing and Materials. Copies of the following documents can be obtained at a nominal cost from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM F 1166-8	Standard Practice for Human Engineering Design Criteria for Marine Systems, Equipment and Facilities.

70.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Copies of the following documents can be obtained at a nominal cost from the ASHRAE, 1791 Tullie Circle, NE, Atlanta, GA 30329.

ASHRAE 55-81	Thermal Environmental Conditions for Human Occupancy
ASHRAE 62-81	Ventilation for Acceptable Indoor Air Quality Guide and Data Book (latest edition)

70.4 Illuminating Engineering Society (IES) of North America. Copies of the following document can be obtained at a nominal cost from the IES, 345 East 47th Street, New York, NY 10017.

IES Lighting HDBK	SEC 9 Application-87, Industrial Lighting

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