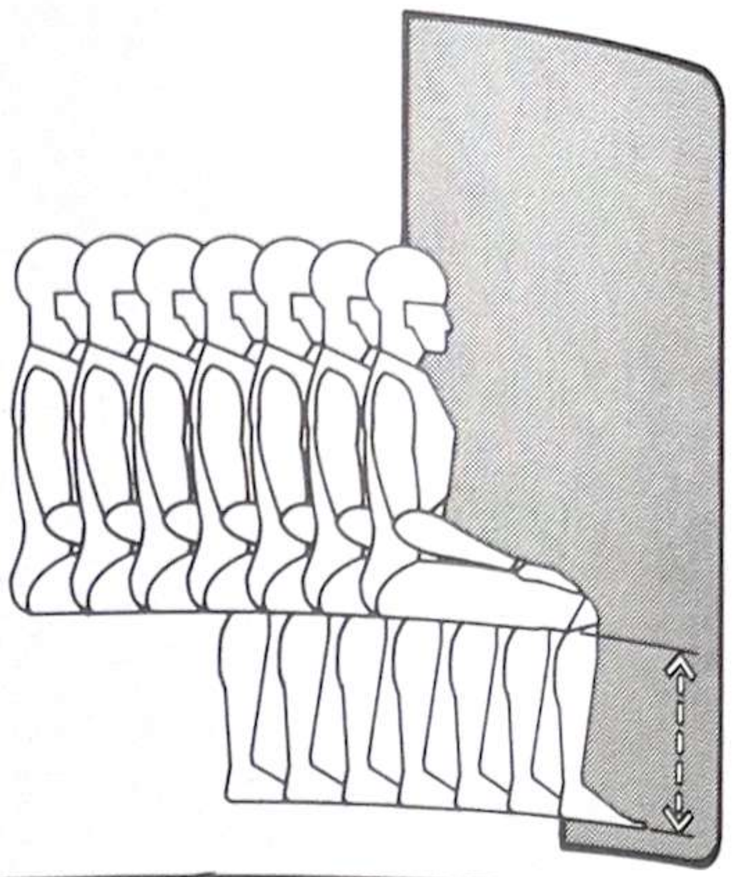
2J

POPLITEAL HEIGHT



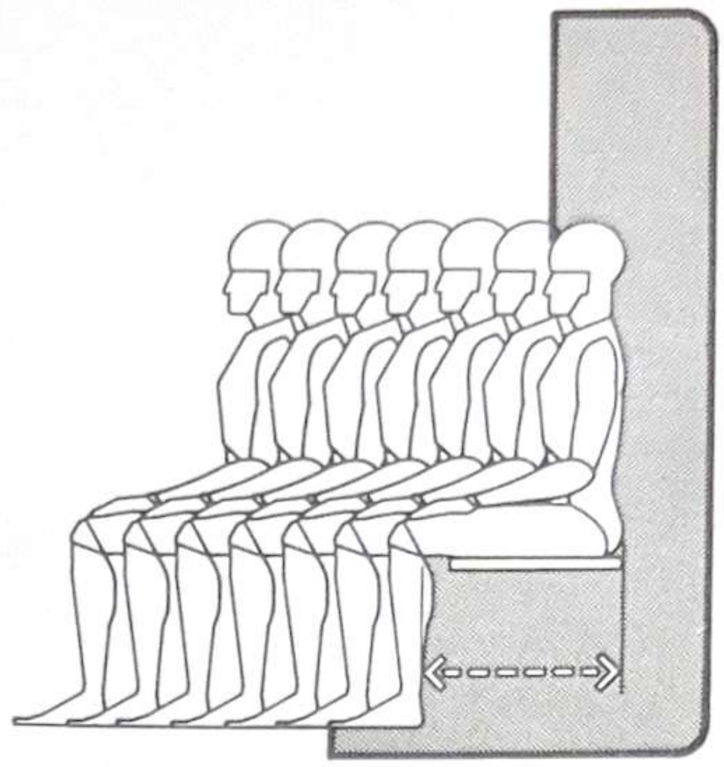
Adult Male and Female Popliteal Height* in Inches and Centimeters by Age, Sex, and Selected Percentiles†

		18 to 79 (Total)		18 to 24 Years		25 to 34 Years		35 to 44 Years		45 to 54 Years		55 to 64 Years		65 to 74 Years		75 to 79 Years	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
99	MEN	20.0	50.8	20.4	51.8	20.6	52.3	19.9	50.5	19.9	50.5	19.8	50.3	19.8	50.3	19.3	49.0
	WOMEN	18.0	45.7	18.5	47.0	18.2	46.2	17.9	45.5	18.3	46.5	17.9	45.5	17.9	45.5	17.8	45.2
95	**MEN**	**19.3**	**49.0**	**19.6**	**49.8**	**19.7**	**50.0**	**19.1**	**48.5**	**19.1**	**48.5**	**19.0**	**48.3**	**18.9**	**48.0**	**18.4**	**46.7**
	WOMEN	**17.5**	**44.5**	**17.8**	**45.2**	**17.5**	**44.5**	**17.5**	**44.5**	**17.5**	**44.5**	**17.1**	**43.4**	**17.0**	**43.2**	**17.2**	**43.7**
90	MEN	18.8	47.8	19.0	48.3	19.2	48.8	18.8	47.8	18.6	47.2	18.6	47.2	18.4	46.7	17.9	45.5
	WOMEN	17.0	43.2	17.4	44.2	17.0	43.2	17.0	43.2	17.0	43.2	16.8	42.7	16.8	42.7	16.9	42.9
80	MEN	18.2	46.2	18.5	47.0	18.6	47.2	18.2	46.2	17.9	45.5	18.0	45.7	17.8	45.2	17.4	44.2
	WOMEN	16.6	42.2	16.9	42.9	16.7	42.4	16.6	42.2	16.6	42.2	16.4	41.7	16.3	41.4	16.6	42.2
70	MEN	17.8	45.2	18.0	45.7	18.1	46.0	17.8	45.2	17.7	45.0	17.7	45.0	17.6	44.7	17.0	43.2
	WOMEN	16.3	41.4	16.6	42.2	16.4	41.7	16.3	41.4	16.2	41.1	16.1	40.9	15.9	40.4	16.2	41.1
60	MEN	17.6	44.7	17.7	45.0	17.8	45.2	17.6	44.7	17.5	44.5	17.4	44.2	17.3	43.9	16.8	42.7
	WOMEN	16.0	40.6	16.4	41.7	16.1	40.9	16.0	40.6	15.9	40.4	15.7	39.9	15.6	39.6	15.9	40.4
50	MEN	17.3	43.9	17.5	44.5	17.5	44.5	17.3	43.9	17.2	43.7	17.1	43.4	17.1	43.4	16.6	42.2
	WOMEN	15.7	39.9	16.1	40.9	15.8	40.1	15.7	39.9	15.5	39.4	15.4	39.1	15.3	38.9	15.6	39.6
40	MEN	17.0	43.2	17.2	43.7	17.3	43.9	17.0	43.2	17.0	43.2	16.9	42.9	16.8	42.7	16.4	41.7
	WOMEN	15.4	39.1	15.8	40.1	15.6	39.6	15.4	39.1	15.2	38.6	15.0	38.1	15.0	38.1	15.4	39.1
30	MEN	16.7	42.4	17.0	43.2	17.0	43.2	16.7	42.4	16.7	42.4	16.5	41.9	16.5	41.9	16.2	41.1
	WOMEN	15.1	38.4	15.5	39.4	15.3	38.9	15.1	38.4	14.9	37.8	14.7	37.3	14.7	37.3	15.1	38.4
20	MEN	16.4	41.7	16.6	42.2	16.6	42.2	16.4	41.7	16.3	41.4	16.2	41.1	16.2	41.1	15.9	40.4
	WOMEN	14.7	37.3	15.2	38.6	15.0	38.1	14.7	37.3	14.5	36.8	14.4	36.6	14.4	36.6	14.6	37.1
10	MEN	16.0	40.6	16.2	41.1	16.2	41.1	16.1	40.9	16.0	40.6	15.8	40.1	15.6	39.6	15.4	39.1
	WOMEN	14.2	36.1	14.6	37.1	14.4	36.6	14.2	36.1	14.2	36.1	14.1	35.8	14.1	35.8	14.1	35.8
5	**MEN**	**15.5**	**39.3**	**16.0**	**40.6**	**16.0**	**40.6**	**15.6**	**39.6**	**15.5**	**39.4**	**15.3**	**38.9**	**15.2**	**38.6**	**15.2**	**38.6**
	WOMEN	**14.0**	**35.6**	**14.2**	**36.1**	**14.1**	**35.8**	**14.0**	**35.6**	**13.8**	**35.1**	**13.6**	**34.5**	**13.9**	**35.3**	**13.5**	**34.3**
1	MEN	14.9	37.8	15.2	38.6	15.1	38.4	15.0	38.1	14.7	37.3	14.9	37.8	14.2	36.1	15.0	38.1
	WOMEN	13.1	33.3	13.5	34.3	13.2	33.5	13.1	33.3	13.1	33.3	13.1	33.3	13.0	33.0	9.6	24.4

*See Table 1N for definition of popliteal height.
†Measurement below which the indicated percent of people in the given age group fall.

2K

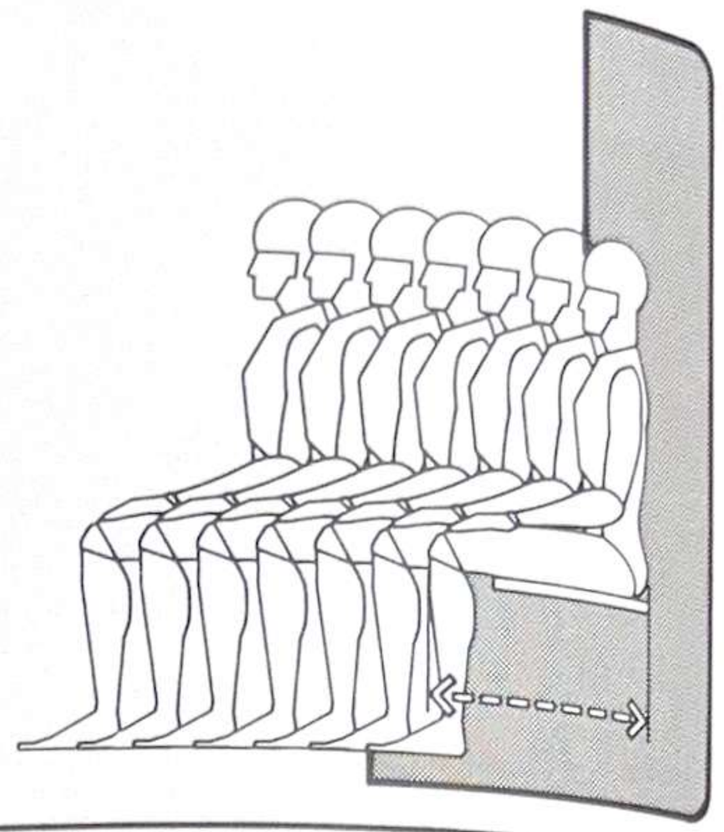
BUTTOCK-POPLITEAL LENGTH



Adult Male and Female Buttock-Popliteal Length* in Inches and Centimeters by Age, Sex, and Selected Percentiles†

		18 to 79 (Total)		18 to 24 Years		25 to 34 Years		35 to 44 Years		45 to 54 Years		55 to 64 Years		65 to 74 Years		75 to 79 Years	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
99	MEN	22.7	57.7	22.9	58.2	23.1	58.7	22.7	57.7	22.0	55.9	22.2	56.4	21.9	55.6	22.1	56.1
	WOMEN	22.0	55.9	21.9	55.6	21.9	55.6	22.4	56.9	22.0	55.9	22.0	55.9	21.9	55.6	20.8	52.8
95	**MEN**	**21.6**	**54.9**	**21.6**	**54.9**	**21.9**	**55.6**	**21.8**	**55.4**	**21.5**	**54.6**	**21.5**	**54.6**	**20.9**	**53.1**	**21.2**	**53.8**
	WOMEN	**21.0**	**53.3**	**21.1**	**53.6**	**21.0**	**53.3**	**21.1**	**53.6**	**20.9**	**53.1**	**21.0**	**53.3**	**20.9**	**53.1**	**20.0**	**50.8**
90	MEN	21.0	53.3	21.0	53.3	21.4	54.4	21.1	53.6	20.9	53.1	20.9	53.1	20.7	52.6	20.8	52.8
	WOMEN	20.6	52.3	20.6	52.3	20.5	52.1	20.7	52.6	20.6	52.3	20.5	52.1	20.4	51.8	19.9	50.5
80	MEN	20.5	52.1	20.5	52.1	20.8	52.8	20.6	52.3	20.5	52.1	20.4	51.8	20.3	51.6	20.2	51.3
	WOMEN	19.9	50.5	19.8	50.3	19.9	50.5	20.0	50.8	20.0	50.8	19.9	50.5	19.8	50.3	19.6	49.8
70	MEN	20.1	51.1	20.0	50.8	20.4	51.8	20.1	51.1	20.1	51.1	20.0	50.8	19.9	50.5	19.7	50.0
	WOMEN	19.5	49.5	19.5	49.5	19.5	49.5	19.6	49.8	19.6	49.8	19.5	49.5	19.4	49.3	19.3	49.0
60	MEN	19.8	50.3	19.7	50.0	20.0	50.8	19.8	50.3	19.7	50.0	19.7	50.0	19.6	49.8	19.2	48.8
	WOMEN	19.2	48.8	19.1	48.5	19.2	48.8	19.3	49.0	19.3	49.0	19.2	48.8	19.1	48.5	19.0	48.3
50	MEN	19.5	49.0	19.5	49.0	19.6	49.8	19.5	49.0	19.5	49.0	19.4	49.3	19.3	49.0	18.9	48.0
	WOMEN	18.9	48.0	18.8	47.8	18.9	48.0	18.9	48.0	18.9	48.0	18.9	48.0	18.8	47.8	18.7	47.5
40	MEN	19.2	48.8	19.2	48.8	19.3	49.0	19.2	48.8	19.2	48.8	19.0	48.3	19.0	48.3	18.6	47.2
	WOMEN	18.6	47.2	18.5	47.0	18.6	47.2	18.6	47.2	18.6	47.2	18.6	47.2	18.5	47.0	18.3	46.5
30	MEN	18.8	47.8	19.0	48.3	19.0	48.3	18.9	48.0	18.8	47.8	18.6	47.2	18.6	47.2	18.3	46.5
	WOMEN	18.2	46.2	18.1	46.0	18.3	46.5	18.3	46.5	18.2	46.2	18.3	46.5	18.2	46.2	18.0	45.7
20	MEN	18.4	46.7	18.5	47.0	18.5	47.0	18.5	47.0	18.3	46.5	18.2	46.2	18.3	46.5	17.9	45.5
	WOMEN	17.9	45.5	17.7	45.0	18.0	45.7	18.0	45.7	17.8	45.2	18.0	47.2	17.8	45.2	17.6	44.7
10	MEN	17.9	45.5	18.0	45.7	18.1	46.0	18.0	45.7	17.8	45.2	17.6	44.7	17.8	45.2	17.3	43.9
	WOMEN	17.3	43.9	17.2	43.7	17.3	43.9	17.4	44.2	17.3	43.9	17.4	44.2	17.3	43.9	17.2	43.7
5	**MEN**	**17.3**	**43.9**	**17.4**	**44.2**	**17.6**	**44.7**	**17.4**	**44.2**	**17.4**	**44.2**	**17.2**	**43.7**	**17.3**	**43.9**	**17.0**	**43.2**
	WOMEN	**17.0**	**43.2**	**16.9**	**42.9**	**17.0**	**43.2**	**17.1**	**43.4**	**17.0**	**43.2**	**17.1**	**43.4**	**16.9**	**42.9**	**17.0**	**43.2**
1	MEN	16.5	41.9	16.5	41.9	16.6	42.1	16.5	41.9	17.0	43.2	16.4	41.7	16.3	41.4	16.2	41.1
	WOMEN	16.1	40.9	16.1	40.9	16.1	40.9	16.2	41.1	15.8	40.1	16.1	40.9	16.1	40.9	14.7	37.3

*See Table 1O for definition of buttock-popliteal length.
†Measurement below which the indicated percent of people in the given age group fall.



2L

BUTTOCK-KNEE LENGTH

Adult Male and Female Buttock-Knee Length* in Inches and Centimeters by Age, Sex, and Selected Percentiles†

		18 to 79 (Total)		18 to 24 Years		25 to 34 Years		35 to 44 Years		45 to 54 Years		55 to 64 Years		65 to 74 Years		75 to 79 Years	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
99	MEN	26.3	66.8	26.5	67.3	26.8	68.1	26.2	66.5	26.1	66.3	25.8	65.5	25.9	65.8	24.9	63.2
	WOMEN	25.7	65.3	25.6	65.0	25.6	65.0	25.9	65.8	25.5	64.8	25.7	65.3	25.9	65.8	24.7	62.7
95	**MEN**	**25.2**	**64.0**	**25.4**	**64.5**	**25.7**	**65.3**	**25.1**	**63.8**	**25.2**	**64.0**	**24.9**	**63.2**	**24.8**	**63.0**	**24.7**	**62.7**
	WOMEN	**24.6**	**62.5**	**24.6**	**62.5**	**24.6**	**62.5**	**24.7**	**62.7**	**24.6**	**62.5**	**24.7**	**62.7**	**24.6**	**62.5**	**23.9**	**60.7**
90	MEN	24.8	63.0	24.9	63.2	25.0	64.0	24.8	63.0	24.8	63.0	24.6	62.5	24.4	62.0	24.4	62.0
	WOMEN	24.0	61.0	23.9	60.7	24.0	61.0	24.0	61.0	24.1	61.2	24.0	61.0	23.9	60.7	23.5	59.7
80	MEN	24.4	62.0	24.4	62.0	24.6	62.5	24.4	62.0	24.4	62.0	24.1	61.2	23.9	60.7	23.9	60.7
	WOMEN	23.4	59.4	23.3	59.2	23.5	59.7	23.5	59.7	23.5	59.7	23.4	59.4	23.4	59.4	22.9	58.2
70	MEN	23.9	60.7	23.9	60.7	24.2	61.5	24.0	61.0	24.0	61.0	23.7	60.2	23.6	59.9	23.3	59.2
	WOMEN	22.9	58.2	22.9	58.2	23.0	58.4	23.0	58.4	22.9	58.2	22.9	58.2	22.9	58.2	22.6	57.4
60	MEN	23.6	59.9	23.6	59.9	23.9	60.7	23.7	60.2	23.7	60.2	23.4	59.4	23.3	59.2	22.9	58.2
	WOMEN	22.6	57.4	22.5	57.2	22.7	57.7	22.7	55.7	22.6	57.4	22.6	57.4	22.6	57.4	22.4	56.9
50	MEN	23.3	59.2	23.3	59.2	23.6	59.9	23.4	59.4	23.4	59.4	23.1	58.7	23.0	58.4	22.6	57.4
	WOMEN	22.4	56.9	22.2	56.4	22.4	56.9	22.5	57.2	22.4	56.9	22.3	56.6	22.2	56.4	22.2	56.4
40	MEN	23.0	58.4	23.0	58.4	23.3	59.2	23.1	58.7	23.1	58.7	22.8	57.9	22.7	57.7	22.3	56.6
	WOMEN	22.1	56.1	21.9	55.6	22.1	56.1	22.2	56.4	22.1	56.1	22.0	55.9	21.9	55.6	21.9	55.6
30	MEN	22.7	57.7	22.7	57.7	22.9	58.2	22.7	57.7	22.7	57.7	22.4	56.9	22.4	56.9	22.0	55.9
	WOMEN	21.7	55.1	21.6	54.9	21.8	55.4	21.9	55.6	21.7	55.1	21.7	55.1	21.5	54.6	21.4	54.4
20	MEN	22.3	56.6	22.3	56.6	22.5	57.2	22.4	56.9	22.4	56.9	22.1	56.1	22.2	56.4	21.6	54.9
	WOMEN	21.3	54.1	21.3	54.1	21.4	54.4	21.5	54.6	21.3	54.1	21.3	54.1	21.2	53.8	21.0	53.3
10	MEN	21.8	55.4	21.9	55.6	22.1	56.1	21.9	55.6	21.9	55.6	21.5	54.6	21.5	54.6	21.2	53.8
	WOMEN	20.9	53.1	20.8	52.8	21.0	53.3	21.1	53.6	20.9	53.1	20.9	53.1	20.6	52.3	20.3	51.6
5	**MEN**	**21.3**	**54.1**	**21.3**	**54.1**	**21.6**	**54.9**	**21.3**	**54.1**	**21.3**	**54.1**	**21.2**	**53.8**	**21.0**	**53.3**	**21.0**	**53.3**
	WOMEN	**20.4**	**51.8**	**20.3**	**51.6**	**20.5**	**52.1**	**20.5**	**52.1**	**20.3**	**51.6**	**20.3**	**51.6**	**20.2**	**51.3**	**19.9**	**50.5**
1	MEN	20.3	51.6	20.4	51.8	20.8	52.8	20.3	51.6	20.4	51.8	19.6	49.8	20.1	51.1	20.2	51.3
	WOMEN	19.5	49.5	19.3	49.0	20.0	51.0	20.0	51.0	19.4	49.3	19.4	49.3	19.4	49.3	18.5	47.0

*See Table 1P for definition of buttock-knee length.
†Measurement below which the indicated percent of people in the given age group fall.

3 ADULT MALE AND FEMALE

MISCELLANEOUS STRUCTURAL BODY DIMENSIONS

DESCRIPTION

Certain selected male and female structural measurements not previously included within the scope of Table 2 are presented in this table. Only 5th and 95th percentile data are indicated since these were deemed to be more useful for design purposes.

SOURCE

A, B, D, E, G Male Data: U.S. Air Force Flying Personnel, 1967; Churchill, Kikta, and Churchill, Aerospace Medical Research Laboratories, Wright-Patterson Air Force Base, Ohio, 1967.

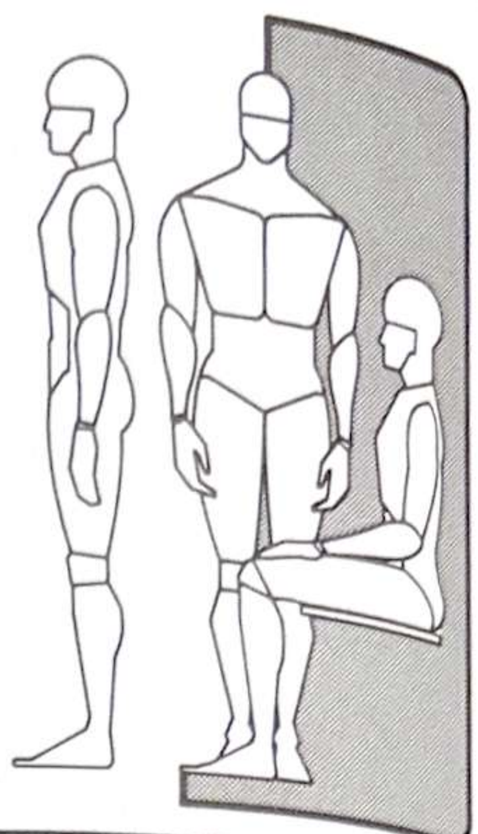
A, E Female Data: Air Force Women, 1968; Clauser, et al., *Anthropometry of Air Force Women*, Technical Report 70-5, Aerospace Medical Research Laboratories, Wright-Patterson Air Force Base, Ohio, 1972.

B, D, G Female Data: Airline Stewardesses, 1971; Snow, Reynolds, and Allgood, *Anthropometry of Airline Stewardesses*, Department of Transportation, Report no. FAA-AM-2, FAA Office of Aviation Medicine, Civil Aeromedical Institute, Oklahoma City, Okla., 1975.

C Male Data: U.S. Air Force Flying Personnel, 1950; Hertzberg, Daniels, and Churchill, *Anthropometry of Flying Personnel, 1950*, Technical Report no. 52-321, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, 1954.

C Female Data: VonCott and Kinkade, *Human Engineering Guide to Equipment Design* (Washington, D.C.: American Institutes for Research), p. 495.

F Male and Female Data: Woodson and Conover, *Human Engineering Guide for Equipment Designers,* 2d ed. (Berkeley and Los Angeles: University of California Press, 1964), pp. 5–16, 5–17, 5–18, 5–19.

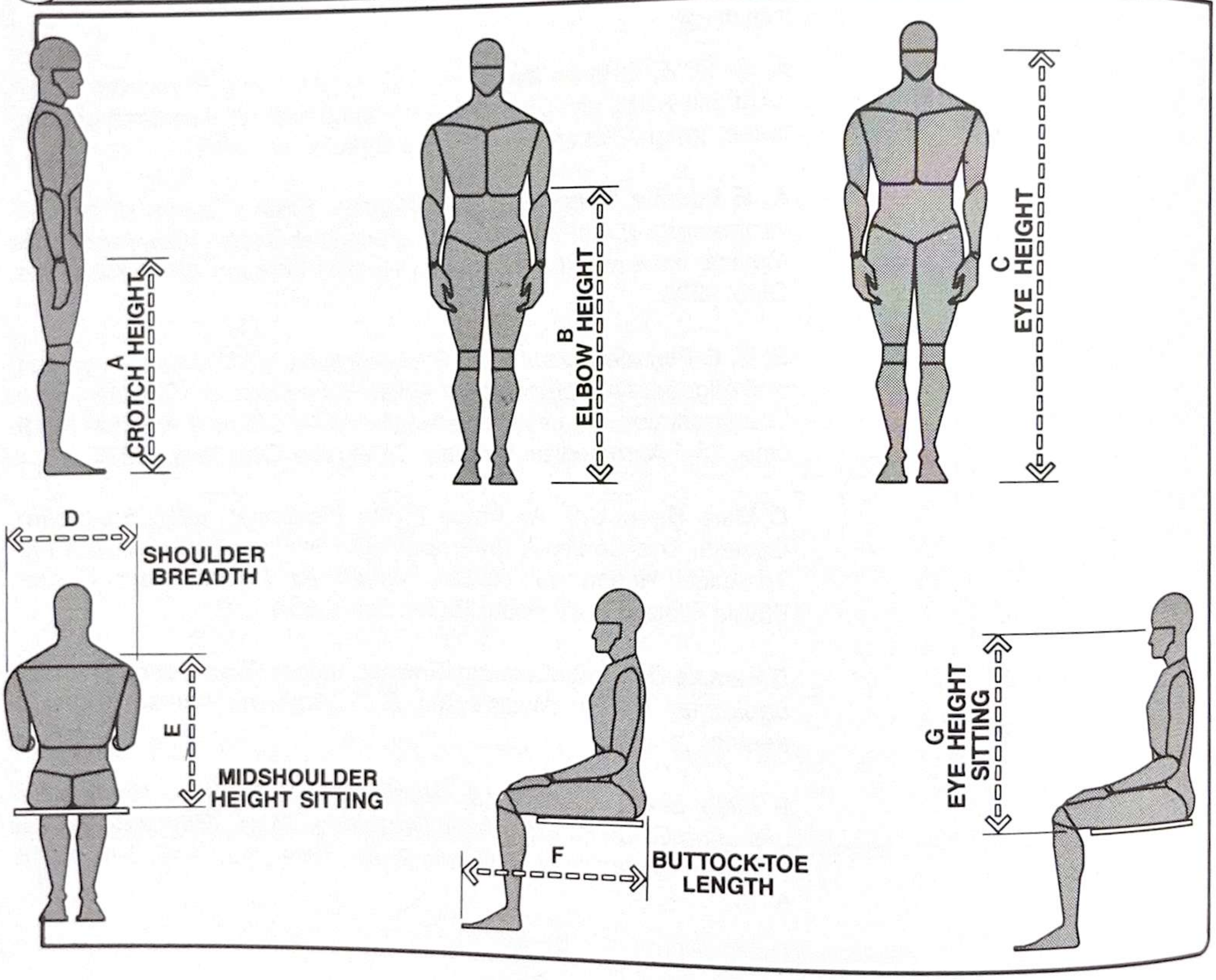


3

MISCELLANEOUS STRUCTURAL BODY DIMENSIONS

Adult Male and Female Miscellaneous Structural Body Dimensions in Inches and Centimeters by Age and Selected Percentiles

		A		B		C		D		E		F		G	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95	MEN	36.2	91.9	47.3	120.1	68.6	174.2	20.7	52.6	27.3	69.3	37.0	94.0	33.9	86.1
	WOMEN	32.0	81.3	43.6	110.7	64.1	162.8	17.0	43.2	24.6	62.5	37.0	94.0	31.7	80.5
5	MEN	30.8	78.2	41.3	104.9	60.8	154.4	17.4	44.2	23.7	60.2	32.0	81.3	30.0	76.2
	WOMEN	26.8	68.1	38.6	98.0	56.3	143.0	14.9	37.8	21.2	53.8	27.0	68.6	28.1	71.4



4 ADULT MALE AND FEMALE FUNCTIONAL BODY DIMENSIONS

DESCRIPTION

Table 4 provides functional dimensions for males and females not included within the scope of Table 2. Only 5th and 95th percentile measurements are indicated since these were deemed to be the most useful for design purposes.

SOURCE

A Male Data: U.S. Air Force Flying Personnel, 1967; Churchill, Kikta, and Churchill, Aerospace Medical Research Laboratories, Wright-Patterson Air Force Base, Ohio, 1967.

A, D, F Female Data: Air Force Women, 1968; Clauser, et al., *Anthropometry of Air Force Women*, Technical Report 70-5, Aerospace Medical Research Laboratories, Wright-Patterson Air Force Base, Ohio, 1972.

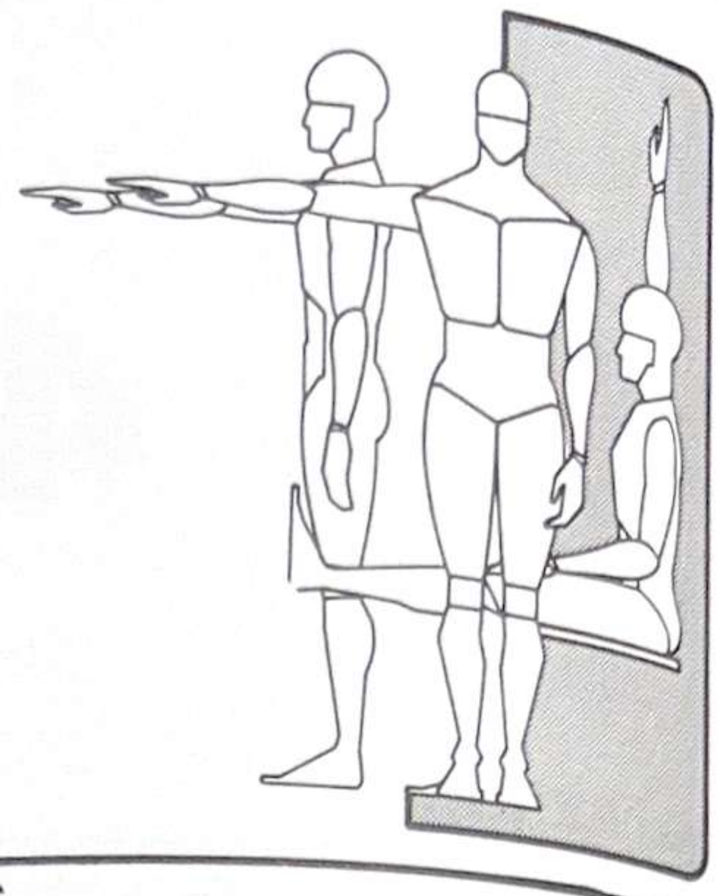
B, D Male Data: U.S. Air Force Flying Personnel, 1950; Hertzberg, Daniels, and Churchill, *Anthropometry of Flying Personnel, 1950*, Technical Report no. 52-321, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, 1954.

B, E Female and E Male Data: Woodson and Conover, *Human Engineering Guide for Equipment Designers,* 2d ed. (Berkeley and Los Angeles: University of California Press, 1964), pp. 5–16, 5–17, 5–18, 5–19.

C Male Data: Snow and Snyder, *Anthropometry of Air Traffic Control Trainees*, Report no. AM 65-26 (September 1965), Federal Aviation Agency, Oklahoma City, Okla.

C Female Data: Airline Stewardesses, 1971; Snow, Reynolds, and Allgood, *Anthropometry of Airline Stewardesses*, Department of Transportation, Report no. FAA-AM-2, FAA Office of Aviation Medicine, Civil Aeromedical Institute, Oklahoma City, Okla., 1975.

F Male Data: Hertzberg, et al., *The Anthropometry of Working Positions*, Report no. WADC TR-54-520, Wright-Patterson Air Force Base, Ohio, 1956.

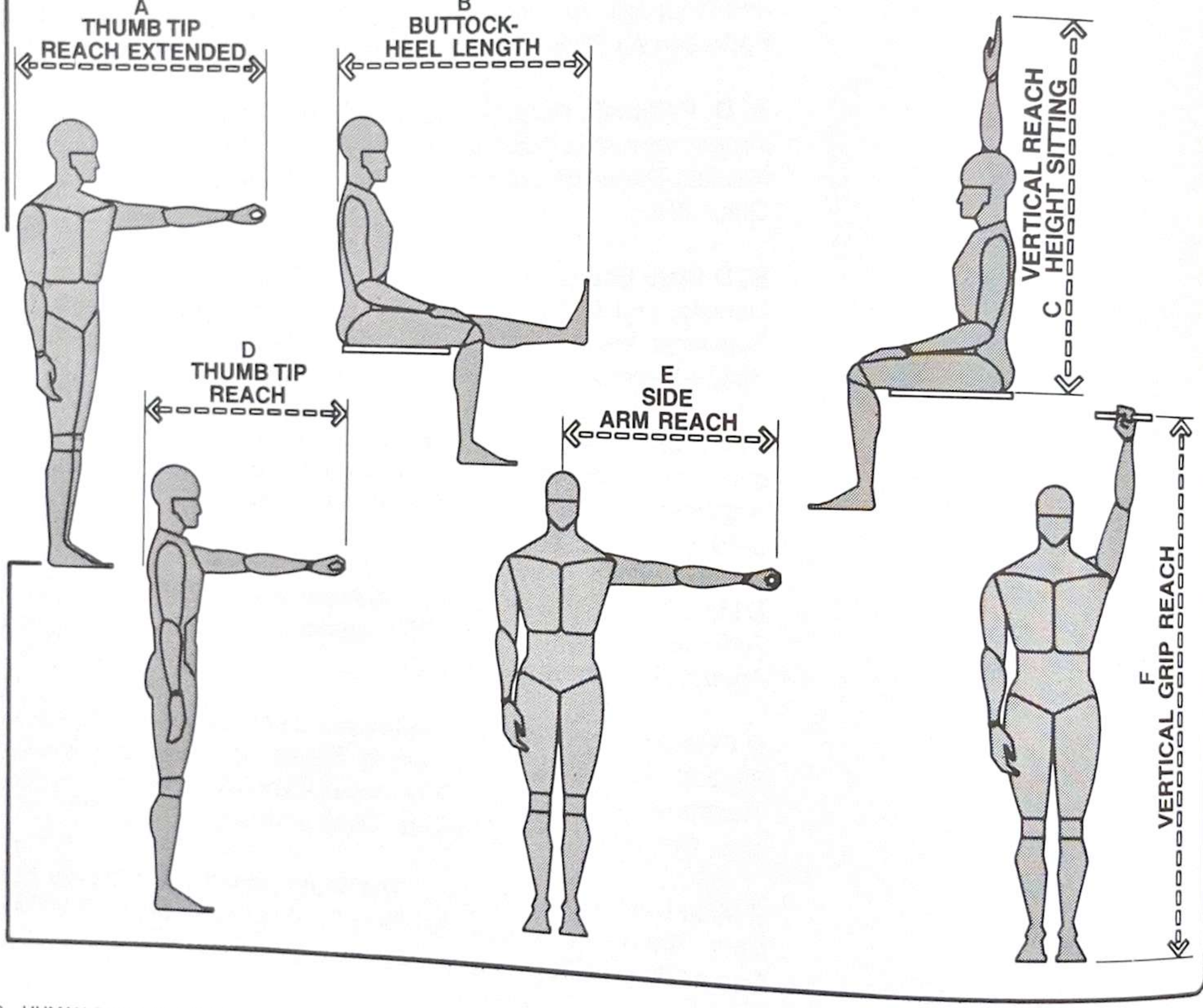


4

FUNCTIONAL BODY DIMENSIONS

Adult Male and Female Functional Body Dimensions in Inches and Centimeters by Age, Sex, and Selected Percentiles

		A		B		C		D		E		F	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95	MEN	38.3	97.3	46.1	117.1	51.6	131.1	35.0	88.9	39.0	86.4	88.5	224.8
	WOMEN	36.3	92.2	49.0	124.5	49.1	124.7	31.7	80.5	38.0	96.5	84.0	213.4
5	MEN	32.4	82.3	39.4	100.1	59.0	149.9	29.7	75.4	29.0	73.7	76.8	195.1
	WOMEN	29.9	75.9	34.0	86.4	55.2	140.2	26.6	67.6	27.0	68.6	72.9	185.2



5 ADULT MALE AND FEMALE

PROJECTED 1985 BODY DIMENSIONS

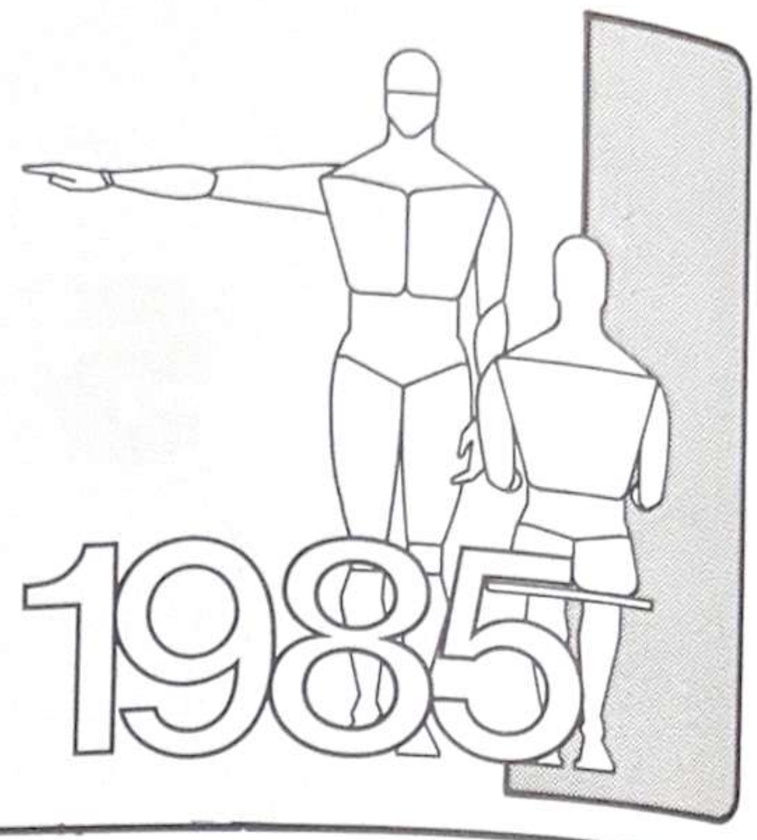
DESCRIPTION

In Part A, secular changes in the body size of populations, over periods of time, were discussed. It was noted, for example, that the body size of Second World War inductees was greater than that of First World War inductees. A recent study by the U.S. Department of Health, Education, and Welfare, taken in 1971–1974, indicates that relatively more men and women are taller than those examined in the National Health Survey of 1960–1962. Fifty-one percent of the men in the recent survey were 175.3 cm, or 69 in, or taller as compared with 38 percent in the 1960–1962 survey. Recognizing the significance of secular change, as well as the length of the research and development cycle associated with the design and production of various equipment—a process typical of certain industries—projections of future body measurements can at times prove extremely useful. At the very least the inclusion of certain projections in these tables can, to some degree, complete the spectrum of anthropometric data available to the architect and interior designer. Table 5 includes such projections. Selected anticipated female and male structural body measurements for the year 1985 are shown. Only 5th and 95th percentile measurements are indicated since they were deemed to be most useful for design purposes.

The male measurements reflect extrapolations made on the basis of data from a number of surveys of U.S. Air Force (USAF) and U.S. Navy Flying Personnel conducted between 1950 and 1973. The data were restricted to those from commissioned officers in the 23–25 age range. The female measurements were estimated from a 1968 Air Force Women's survey. Unfortunately, there was no corresponding large group of surveys on which to study secular changes in dimensions of female officers. Proper allowances for clothing and shoes should be added to all data.

SOURCE

Anthropometric Source Book, Volume I: Anthropometry for Designers, NASA reference publication 1024, National Aeronautics and Space Administration, Scientific and Technical Information Office, July 1978.



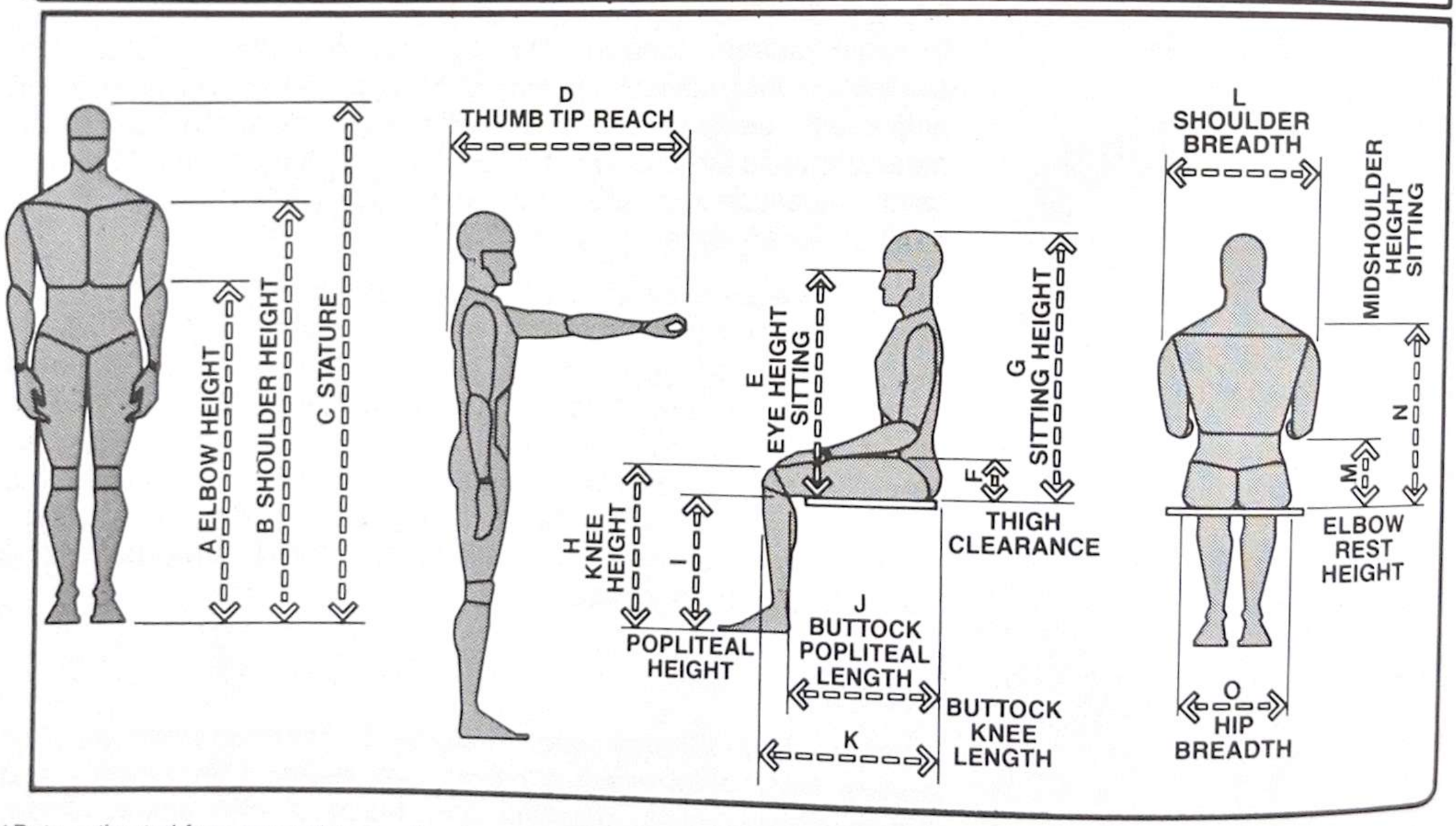
5

PROJECTED 1985 BODY DIMENSIONS

Adult Male and Female Projected 1985 Body Dimensions in Inches and Centimeters by Sex and Selected Percentiles

		Weight		A		B		C		D		E		F		G	
		lb	kg	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95	MEN	215.4	97.7	47.6	120.9	61.3	155.7	74.3	188.6	34.4	87.4	34.1	86.5	7.5	19.1	39.0	99.0
	WOMEN	165.1	74.9	42.8*	108.7	55.7	141.4	68.0	172.8	31.7	80.6	31.3	79.6	5.9	14.9	36.0	91.5
5	MEN	143.7	65.2	41.5	105.5	53.7	136.5	66.2	168.2	29.3	74.3	30.1	76.4	5.7	14.5	34.8	88.5
	WOMEN	104.5	47.4	38.0*	96.5	48.4	122.9	60.0	152.3	26.7	67.7	27.4	69.5	4.1	10.4	32.0	81.2

		H		I		J		K		L		M		N		O	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95	MEN	23.7	60.3	18.8	47.8	21.7	55.1	25.7	65.4	20.8	52.9	11.7	29.7	27.4	69.6	16.6	42.2
	WOMEN	21.4*	54.3	17.4	44.2	20.7	52.7	24.4	62.0	18.4	46.8	10.7	27.1	24.8	63.1	16.4	41.6
5	MEN	20.5	52.1	15.9	40.4	18.3	46.4	22.2	56.4	17.5	44.4	8.3	21.0	23.9	60.6	13.5	34.4
	WOMEN	18.4*	46.7	14.9	37.8	17.2	43.7	21.0	53.3	15.2	38.6	7.6	19.2	21.3	54.2	13.9	35.4



*Data estimated from regression equations.

6 ADULT MALE WORKING POSITIONS

DESCRIPTION

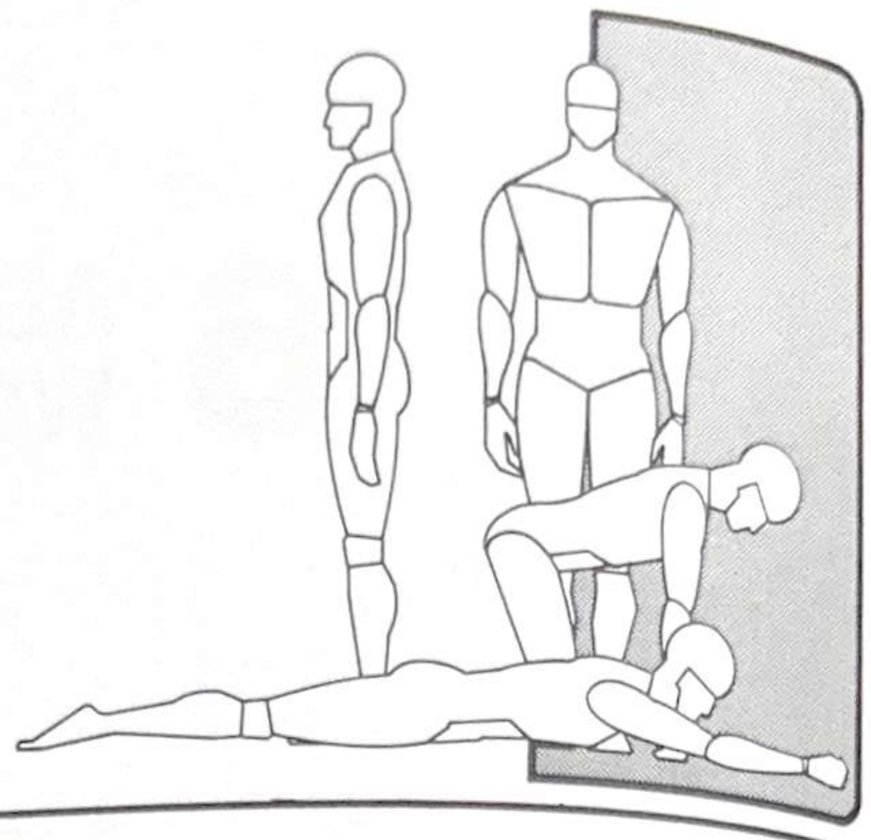
Table 6 provides various 5th and 95th percentile body dimensions of kneeling, crawling, and prone positions not included in the data indicated in the other tables. This information is useful to the architect and interior designer in the planning of mechanical and utility spaces, exercise rooms, physical therapy spaces, and other similar areas. Proper allowances for clothing and shoes should be added to all data.

SOURCE

Human Factors Engineering, 3d ed., AFSC Design Handbook 1-3/1 January 1977, Department of the Air Force, Headquarters Air Force Systems Command Andrews AFB, DC 20334, p. 8. The data used from AFSC DH 1-3 was, in turn, extracted from H. T. E. Hertzberg, I. Emanuel, and M. Alexander, *The Anthropometry of Working Positions,* WADC-TR-54-520 [Yellow Springs, Ohio: Antioch College, August 1956 (DDC N° AD 110573)]; and Albert Damon, Howard W. Stoudt, Ross McFarland, *The Human Body in Equipment Design* (Cambridge, Mass.: Harvard University Press, 1971), pp. 134–136.

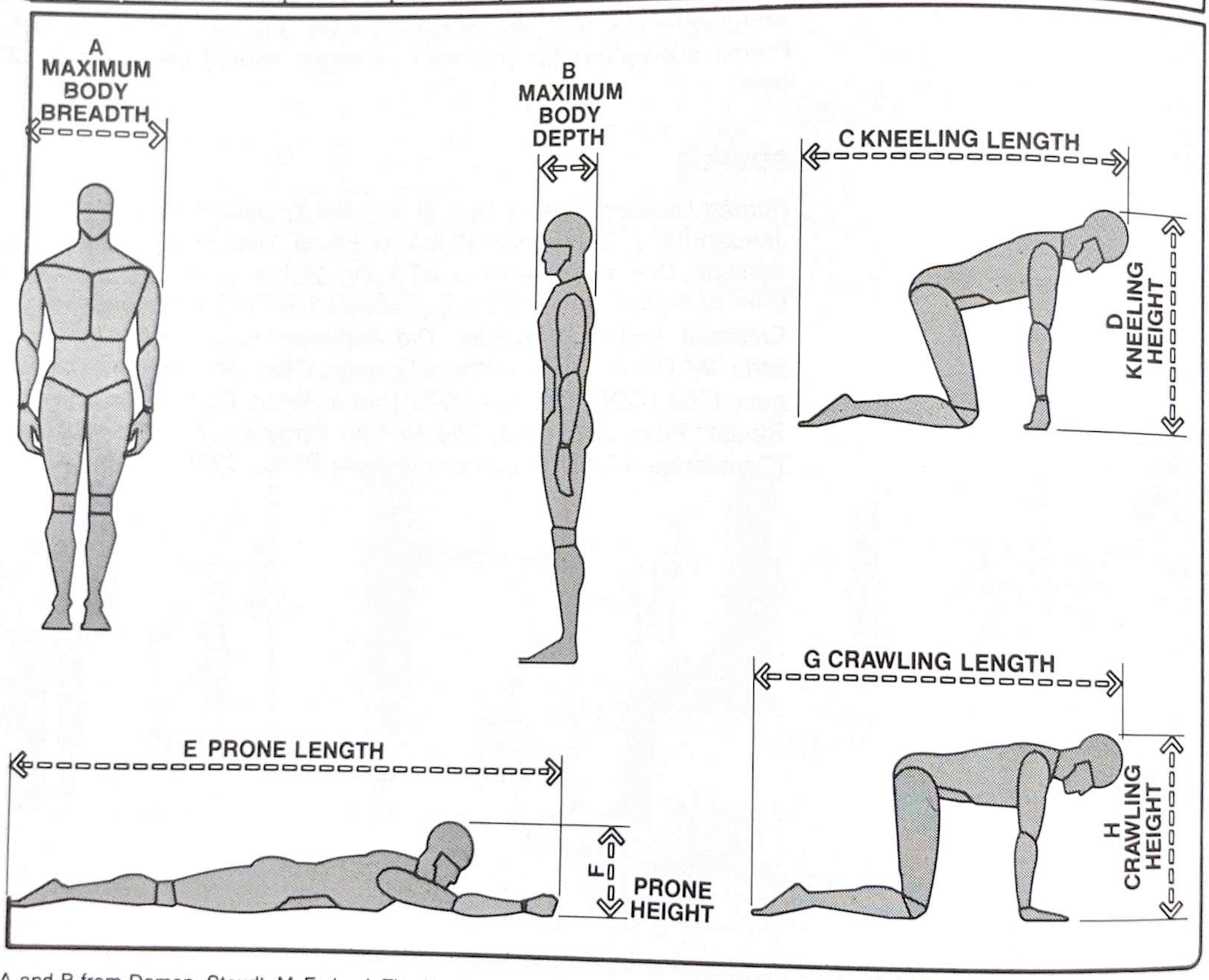
6

WORKING POSITIONS



Adult Male Working Positions in Inches and Centimeters and by Selected Percentiles*

		A	B	C	D	E	F	G	H
95	in	22.8	13.0	48.1	34.5	95.8	16.4	58.2	30.5
	cm	57.9	33.0	122.2	87.6	243.3	41.7	147.8	77.5
5	in	18.8	10.1	37.6	29.7	84.7	12.3	49.3	26.2
	cm	47.8	25.7	95.5	75.4	215.1	31.2	125.2	66.5



*A and B from Damon, Stoudt, McFarland, *The Human Body in Equipment Design.* C through H from *Human Factors Engineering.*

7 CHILDREN AGES 6 TO 11

WEIGHT AND STRUCTURAL BODY DIMENSIONS

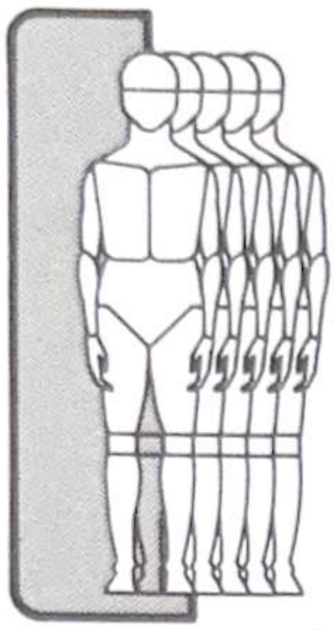
DESCRIPTION

To date, very little anthropometric data have been available to the designer with regard to functional body measurements of infants and children. Such information is vital to the proper design of juvenile furniture and preschool, school, and other interior environments for use by children. What makes the need for such data even more critical is that the element of safety as well as comfort is at stake. There is a strong relationship between improperly designed furniture and accidental death and injury to children. Cases of strangulation and neck impingement in cribs and high chairs, for example, are not uncommon. Table 7 provides some anthropometric data in the form of body measurements of children from 6 to 11 years of age in the United States from 1963 to 1965. Although the measurements are structural rather than functional, they should be useful to the designer. (The measurements were converted from centimeters to inches, which explains why there are some discrepancies within the tables.) Proper allowances for clothing and shoes should be added to all data.

For additional anthropometric data concerning infants and children, a 1975 study prepared by Snyder, Spencer, Owings, and Schneider, all of the University of Michigan, for the Society of Automotive Engineers, entitled *Anthropometry of U.S. Infants and Children*, is highly recommended.

SOURCE

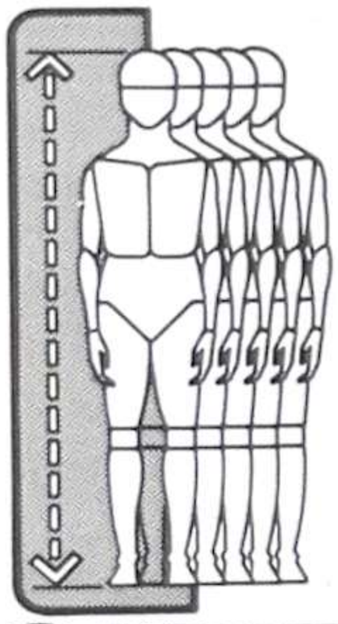
Robert M. Malina, Peter V. V. Hamill, and Stanley Lemeshow, *National Health Examination Survey: Selected Body Measurements of Children 6–11 Years, 1963–1965* (Washington, D.C.: U.S. Government Printing Office, Vital and Health Statistics Series 11, no. 123, DHEW publication no. (HSM) 73-1605.



7A
WEIGHT

Weight of Children in Pounds and Kilograms by Age, Sex, and Selected Percentiles

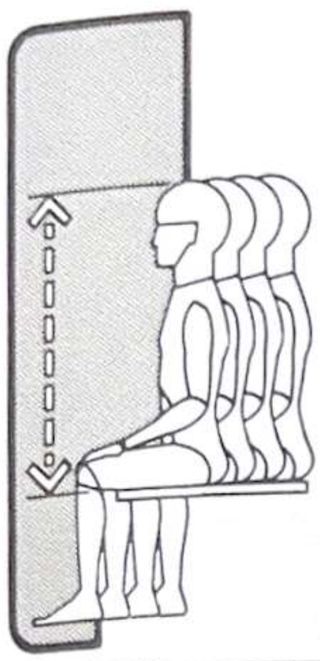
		6 Years		7 Years		8 Years		9 Years		10 Years		11 Years	
		lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
95	**BOYS**	**61.7**	**28.0**	**69.4**	**31.5**	**80.2**	**36.4**	**95.9**	**43.5**	**99.2**	**45.0**	**116.8**	**53.0**
	GIRLS	**61.7**	**28.0**	**69.4**	**31.5**	**84.2**	**38.2**	**100.5**	**45.6**	**110.0**	**49.9**	**127.9**	**58.0**
90	BOYS	57.3	26.0	65.0	29.5	74.7	33.9	84.9	38.5	92.6	42.0	107.1	48.6
	GIRLS	56.9	25.8	65.5	29.7	76.1	34.5	92.2	41.8	100.5	45.6	114.9	52.1
75	BOYS	52.2	23.7	58.6	26.6	65.7	29.8	74.7	33.9	80.5	36.5	91.9	41.7
	GIRLS	51.1	23.2	58.2	26.4	66.1	30.0	76.3	34.6	87.1	39.5	99.2	45.0
50	BOYS	47.6	21.6	53.1	24.1	59.7	27.1	65.5	29.7	71.9	32.6	80.7	36.6
	GIRLS	46.5	21.1	51.8	23.5	58.9	26.7	65.7	29.8	75.4	34.2	84.2	38.2
25	BOYS	43.7	19.8	48.9	22.2	54.0	24.5	59.1	26.8	64.8	29.4	73.0	33.1
	GIRLS	42.3	19.2	47.0	21.3	52.5	23.8	58.6	26.6	64.4	29.2	73.6	33.4
10	BOYS	40.1	18.2	45.0	20.4	49.8	22.6	54.0	24.5	58.9	26.7	65.4	30.1
	GIRLS	38.8	17.6	43.0	19.5	47.8	21.7	53.6	24.3	57.8	26.2	65.7	29.8
5	**BOYS**	**38.4**	**17.4**	**42.8**	**19.4**	**47.4**	**21.5**	**51.1**	**23.2**	**56.2**	**25.5**	**63.0**	**28.6**
	GIRLS	**36.2**	**16.4**	**41.2**	**18.7**	**45.2**	**20.5**	**50.5**	**22.9**	**54.9**	**24.9**	**62.6**	**28.4**



7B
STATURE

Stature of Children in Inches and Centimeters by Age, Sex, and Selected Percentiles

		6 Years		7 Years		8 Years		9 Years		10 Years		11 Years	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95	**BOYS**	**50.4**	**128.0**	**52.9**	**134.4**	**54.8**	**139.3**	**57.2**	**145.4**	**59.6**	**151.3**	**61.8**	**157.0**
	GIRLS	**49.9**	**126.7**	**52.2**	**132.7**	**54.8**	**139.3**	**58.0**	**147.4**	**60.4**	**153.4**	**62.9**	**159.7**
90	BOYS	49.5	125.7	51.9	131.8	54.1	137.3	56.5	143.5	58.5	148.5	60.7	154.3
	GIRLS	49.2	125.0	51.5	130.7	54.0	137.2	57.0	144.8	59.1	150.2	62.2	158.0
75	BOYS	48.0	122.0	50.4	128.0	52.6	133.7	55.2	140.1	56.9	144.6	59.2	150.4
	GIRLS	47.9	121.6	50.2	127.4	52.5	133.4	55.2	140.1	57.4	145.7	60.2	152.8
50	BOYS	46.7	118.5	49.0	124.4	51.2	130.0	53.4	135.6	55.4	140.6	57.4	145.8
	GIRLS	46.3	117.7	48.7	123.6	51.0	129.6	53.3	135.4	55.5	141.0	58.0	147.4
25	BOYS	45.3	115.1	47.6	120.8	49.7	126.3	51.7	131.4	53.6	136.2	55.6	141.2
	GIRLS	45.0	114.4	47.1	119.7	49.4	125.5	51.5	130.8	53.5	135.9	56.3	143.0
10	BOYS	44.0	111.8	46.4	117.8	48.5	123.3	50.0	127.0	51.7	131.4	54.0	137.2
	GIRLS	43.5	110.6	45.8	116.3	47.8	121.4	50.0	127.1	52.0	132.0	54.7	138.9
5	**BOYS**	**43.6**	**110.7**	**45.5**	**115.6**	**47.4**	**120.3**	**49.1**	**124.6**	**50.9**	**129.3**	**53.0**	**134.6**
	GIRLS	**42.6**	**108.3**	**44.8**	**113.7**	**46.9**	**119.1**	**49.0**	**124.4**	**51.0**	**129.5**	**53.3**	**135.4**

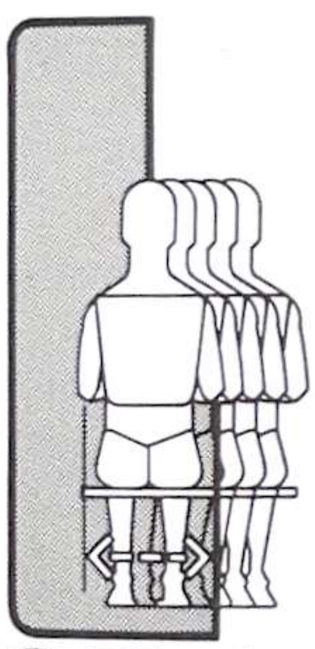


7C

SITTING HEIGHT ERECT

Sitting Height Erect of Children in Inches and Centimeters by Age, Sex, and Selected Percentiles

	6 Years		7 Years		8 Years		9 Years		10 Years		11 Years	
	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95 **BOYS**	**27.4**	**69.5**	**28.2**	**71.7**	**29.2**	**74.1**	**30.2**	**76.6**	**30.9**	**78.5**	**31.7**	**80.6**
95 **GIRLS**	**27.1**	**68.8**	**28.1**	**71.3**	**28.9**	**73.3**	**30.1**	**76.4**	**31.1**	**79.1**	**32.8**	**83.4**
90 BOYS	26.9	68.3	27.8	70.6	28.8	73.2	29.7	75.5	30.4	77.2	31.3	79.5
90 GIRLS	26.7	67.9	27.7	70.3	28.5	72.4	29.6	75.3	30.6	77.6	32.0	81.4
75 BOYS	26.2	66.5	27.0	68.7	28.1	71.3	29.0	73.6	29.6	75.2	30.5	77.5
75 GIRLS	25.9	65.8	26.9	68.2	27.8	70.7	28.9	73.3	29.8	75.6	31.0	78.7
50 BOYS	25.5	64.7	26.4	67.1	27.3	69.3	28.1	71.4	28.8	73.1	29.7	75.4
50 GIRLS	25.2	64.1	26.1	66.3	27.0	68.6	27.9	70.8	28.9	73.4	30.0	76.1
25 BOYS	24.7	62.8	25.6	65.1	26.5	67.3	27.2	69.2	28.0	71.0	28.9	73.3
25 GIRLS	24.4	62.1	25.2	64.1	26.2	66.5	27.0	68.7	27.3	70.7	29.1	73.8
10 BOYS	24.1	61.1	25.0	63.5	25.8	65.5	26.3	66.8	27.2	69.0	28.1	71.3
10 GIRLS	23.7	60.1	24.5	62.3	25.4	64.4	26.3	66.7	27.1	68.8	28.2	71.6
5 **BOYS**	**23.7**	**60.2**	**24.6**	**62.4**	**25.4**	**64.5**	**25.9**	**65.9**	**26.5**	**67.4**	**27.6**	**70.1**
5 **GIRLS**	**23.1**	**58.8**	**24.1**	**61.2**	**24.8**	**63.1**	**25.8**	**65.5**	**26.7**	**67.8**	**27.4**	**69.7**

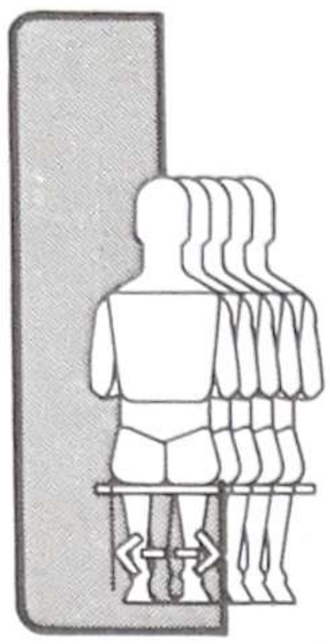


7D

ELBOW-TO-ELBOW BREADTH

Elbow-to-Elbow Breadth of Children in Inches and Centimeters by Age, Sex, and Selected Percentiles

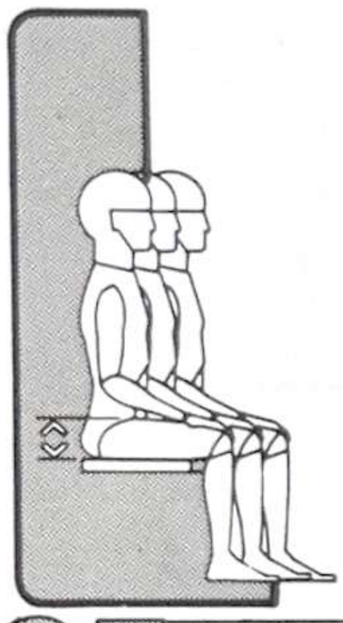
	6 Years		7 Years		8 Years		9 Years		10 Years		11 Years	
	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95 **BOYS**	**11.3**	**28.8**	**11.9**	**30.2**	**12.4**	**31.6**	**13.7**	**34.7**	**13.5**	**34.4**	**14.7**	**37.3**
95 **GIRLS**	**11.1**	**28.1**	**11.6**	**29.5**	**12.4**	**31.6**	**13.5**	**34.2**	**14.2**	**36.1**	**14.7**	**37.4**
90 BOYS	11.0	28.0	11.5	29.2	11.9	30.1	12.6	32.1	12.8	32.6	13.7	34.9
90 GIRLS	10.6	26.9	11.1	28.3	11.7	29.7	12.5	31.7	13.1	33.4	13.9	35.2
75 BOYS	10.6	26.8	10.9	27.6	11.3	28.6	11.6	29.5	12.0	30.5	12.6	32.1
75 GIRLS	10.0	25.4	10.4	26.4	10.9	27.7	11.3	28.8	12.0	30.4	12.6	32.1
50 BOYS	10.0	25.3	10.3	26.2	10.6	26.8	10.8	27.5	11.2	28.5	11.7	29.7
50 GIRLS	9.4	24.0	9.7	24.6	10.1	25.7	10.4	26.5	10.9	27.7	11.5	29.2
25 BOYS	9.3	23.7	9.6	24.5	10.0	25.3	10.2	25.9	10.6	27.0	11.0	27.9
25 GIRLS	8.9	22.5	9.1	23.1	9.5	24.1	9.8	24.8	10.1	25.7	10.6	26.8
10 BOYS	8.9	22.5	9.1	23.1	9.4	23.8	9.6	24.4	10.0	25.3	10.4	26.5
10 GIRLS	8.4	21.4	8.7	22.0	8.8	22.3	9.3	23.5	9.5	24.2	10.0	25.3
5 **BOYS**	**8.5**	**21.7**	**8.8**	**22.3**	**9.1**	**23.1**	**9.3**	**23.5**	**9.6**	**24.3**	**10.1**	**25.6**
5 **GIRLS**	**8.3**	**21.0**	**8.4**	**21.3**	**8.4**	**21.4**	**9.1**	**23.0**	**9.2**	**23.4**	**9.6**	**24.5**



7E
HIP BREADTH

Hip Breadth of Children in Inches and Centimeters by Age, Sex, and Selected Percentiles

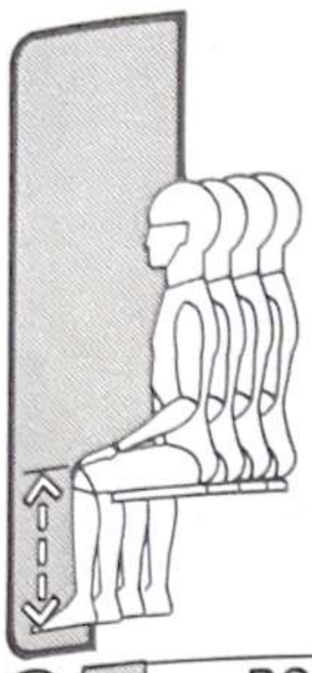
		6 Years		7 Years		8 Years		9 Years		10 Years		11 Years	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95	**BOYS**	**9.3**	**23.5**	**9.6**	**24.5**	**10.4**	**26.3**	**11.3**	**28.8**	**11.4**	**28.9**	**12.0**	**30.6**
	GIRLS	**9.3**	**23.7**	**10.1**	**25.7**	**10.6**	**26.9**	**11.5**	**29.2**	**12.3**	**31.2**	**13.3**	**33.8**
90	BOYS	8.9	22.6	9.3	23.6	9.8	24.9	10.6	26.8	10.8	27.5	11.5	29.3
	GIRLS	9.0	22.8	9.7	24.6	10.2	25.9	11.0	28.0	11.6	29.5	12.4	31.6
75	BOYS	8.5	21.5	8.8	22.4	9.3	23.5	9.7	24.7	10.1	25.6	10.7	27.3
	GIRLS	8.5	21.7	9.0	22.9	9.6	24.4	10.1	25.7	10.7	27.3	11.3	28.8
50	BOYS	8.1	20.5	8.4	21.3	8.8	22.3	9.2	23.3	9.5	24.1	10.0	25.5
	GIRLS	8.1	20.5	8.5	21.6	9.0	22.8	9.3	23.6	9.9	25.2	10.5	26.6
25	BOYS	7.7	19.5	8.0	20.3	8.3	21.2	8.7	22.1	8.9	22.7	9.4	23.9
	GIRLS	7.6	19.4	8.0	20.4	8.4	21.4	8.8	22.4	9.2	23.4	9.8	24.9
10	BOYS	7.3	18.6	7.6	19.4	8.0	20.2	8.3	21.0	8.5	21.7	8.9	22.7
	GIRLS	7.3	18.5	7.6	19.4	8.0	20.3	8.4	21.3	8.7	22.1	9.1	23.2
5	**BOYS**	**7.1**	**18.1**	**7.5**	**19.1**	**7.7**	**19.6**	**8.0**	**20.3**	**8.3**	**21.1**	**8.7**	**22.1**
	GIRLS	**7.1**	**18.1**	**7.4**	**18.7**	**7.8**	**19.7**	**8.1**	**20.6**	**8.4**	**21.3**	**8.8**	**22.3**



7F
THIGH CLEARANCE

Thigh Clearance of Children in Inches and Centimeters by Age, Sex, and Selected Percentiles

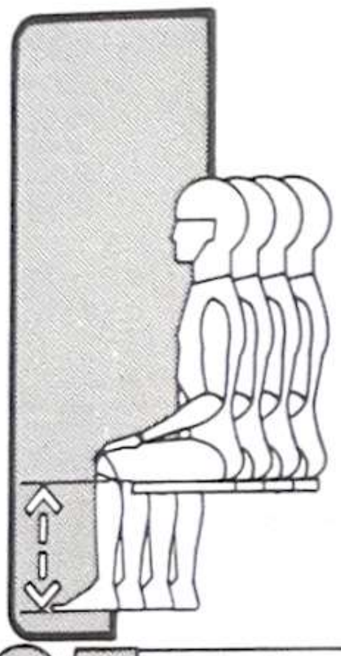
		6 Years		7 Years		8 Years		9 Years		10 Years		11 Years	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95	**BOYS**	**4.3**	**11.0**	**4.6**	**11.7**	**5.0**	**12.6**	**5.5**	**13.9**	**5.4**	**13.7**	**5.8**	**14.7**
	GIRLS	**4.5**	**11.5**	**4.8**	**12.2**	**5.1**	**12.9**	**5.4**	**13.8**	**5.6**	**14.3**	**5.9**	**14.9**
90	BOYS	4.2	10.7	4.5	11.4	4.7	11.9	5.1	12.9	5.2	13.1	5.5	13.9
	GIRLS	4.3	10.8	4.5	11.5	4.9	12.4	5.2	13.3	5.4	13.6	5.6	14.3
75	BOYS	3.9	9.9	4.1	10.5	4.4	11.2	4.6	11.7	4.7	11.9	5.0	12.8
	GIRLS	3.9	10.0	4.1	10.5	4.4	11.3	4.6	11.8	5.0	12.6	5.2	13.1
50	BOYS	3.6	9.1	3.8	9.6	4.1	10.3	4.2	10.7	4.4	11.1	4.6	11.6
	GIRLS	3.6	9.2	3.8	9.6	4.1	10.3	4.2	10.7	4.5	11.4	4.7	11.9
25	BOYS	3.3	8.3	3.5	8.8	3.7	9.4	3.9	9.8	4.0	10.1	4.2	10.6
	GIRLS	3.3	8.4	3.5	8.8	3.7	9.4	3.9	9.8	4.1	10.3	4.2	10.7
10	BOYS	3.0	7.7	3.2	8.2	3.5	8.8	3.6	9.1	3.7	9.3	3.9	9.8
	GIRLS	3.1	7.8	3.2	8.2	3.4	8.7	3.6	9.1	3.7	9.4	4.0	10.1
5	**BOYS**	**2.9**	**7.4**	**3.1**	**7.9**	**3.3**	**8.3**	**3.3**	**8.4**	**3.5**	**9.0**	**3.7**	**9.3**
	GIRLS	**2.9**	**7.4**	**3.1**	**8.0**	**3.2**	**8.2**	**3.3**	**8.5**	**3.5**	**9.0**	**3.7**	**9.4**



7G
KNEE HEIGHT

Knee Height of Children in Inches and Centimeters by Age, Sex, and Selected Percentiles

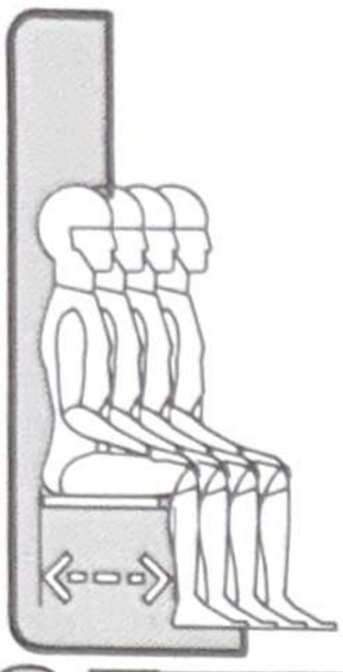
		6 Years		7 Years		8 Years		9 Years		10 Years		11 Years	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95	**BOYS**	**15.6**	**39.7**	**16.6**	**42.2**	**17.2**	**43.8**	**18.4**	**46.7**	**19.1**	**48.6**	**20.0**	**50.9**
	GIRLS	**15.6**	**39.7**	**16.4**	**41.6**	**17.4**	**44.3**	**18.6**	**47.3**	**19.4**	**49.3**	**20.2**	**51.2**
90	BOYS	15.3	38.8	16.3	41.3	16.9	42.9	18.0	45.6	18.7	47.5	19.6	49.8
	GIRLS	15.2	38.7	16.0	40.7	17.0	43.3	18.1	46.1	18.8	47.8	19.8	50.3
75	BOYS	14.7	37.4	15.6	39.6	16.4	41.7	17.2	43.8	18.1	45.9	19.0	48.2
	GIRLS	14.7	37.3	15.6	39.5	16.5	41.8	17.5	44.4	18.3	46.4	19.0	48.3
50	BOYS	14.1	35.9	15.0	38.2	15.8	40.2	16.7	42.4	17.4	44.3	18.2	46.3
	GIRLS	14.1	35.9	14.9	37.8	15.8	40.1	16.7	42.3	17.5	44.4	18.3	46.6
25	BOYS	13.6	34.6	14.4	36.7	15.2	38.6	16.0	40.7	16.7	42.4	17.5	44.4
	GIRLS	13.6	34.5	14.4	36.5	15.2	38.5	15.9	40.5	16.7	42.4	17.6	44.8
10	BOYS	13.2	33.5	14.0	35.5	14.7	37.3	15.4	39.1	16.0	40.7	16.9	42.8
	GIRLS	13.0	33.1	13.9	35.2	14.6	37.2	15.4	39.1	16.0	40.7	16.9	43.0
5	**BOYS**	**13.0**	**32.9**	**13.7**	**34.8**	**14.3**	**36.3**	**15.0**	**38.1**	**15.6**	**39.7**	**16.4**	**41.7**
	GIRLS	**12.8**	**32.4**	**13.5**	**34.3**	**14.3**	**36.3**	**15.0**	**38.2**	**15.6**	**39.6**	**16.6**	**42.1**



7H
POPLITEAL HEIGHT

Popliteal Height of Children in Inches and Centimeters by Age, Sex, and Selected Percentiles

		6 Years		7 Years		8 Years		9 Years		10 Years		11 Years	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95	**BOYS**	**12.8**	**32.6**	**13.6**	**34.6**	**14.1**	**35.8**	**15.0**	**38.0**	**15.6**	**39.7**	**16.3**	**41.3**
	GIRLS	**12.6**	**32.1**	**13.4**	**34.0**	**14.1**	**35.8**	**15.1**	**38.4**	**15.7**	**39.8**	**16.4**	**41.7**
90	BOYS	12.4	31.6	13.3	33.7	13.9	35.2	14.6	37.2	15.4	39.0	15.9	40.4
	GIRLS	12.4	31.4	13.1	33.3	13.7	34.9	14.8	37.6	15.4	39.1	16.0	40.7
75	BOYS	12.0	30.5	12.8	32.4	13.3	33.9	14.1	35.7	14.7	37.4	15.4	39.1
	GIRLS	11.9	30.2	12.6	32.0	13.3	33.7	14.1	35.7	14.7	37.4	15.5	39.3
50	BOYS	11.5	29.3	12.2	31.1	12.9	32.7	13.5	34.3	14.1	35.9	14.7	37.3
	GIRLS	11.4	29.0	12.0	30.6	12.8	32.5	13.5	34.2	14.0	35.6	14.8	37.5
25	BOYS	11.0	28.0	11.7	29.7	12.3	31.3	13.0	32.9	13.5	34.4	14.1	35.7
	GIRLS	10.9	27.7	11.5	29.3	12.2	31.1	12.8	32.6	13.4	34.1	14.1	35.7
10	BOYS	10.6	26.9	11.3	28.6	11.9	30.1	12.4	31.5	13.0	33.0	13.6	34.5
	GIRLS	10.4	26.5	11.1	28.2	11.7	29.6	12.3	31.3	12.8	32.6	13.5	34.2
5	**BOYS**	**10.4**	**26.3**	**11.1**	**28.1**	**11.5**	**29.2**	**12.1**	**30.8**	**12.7**	**32.2**	**13.3**	**33.7**
	GIRLS	**10.2**	**26.0**	**10.8**	**27.4**	**11.5**	**29.1**	**11.9**	**30.3**	**12.5**	**31.8**	**13.1**	**33.3**

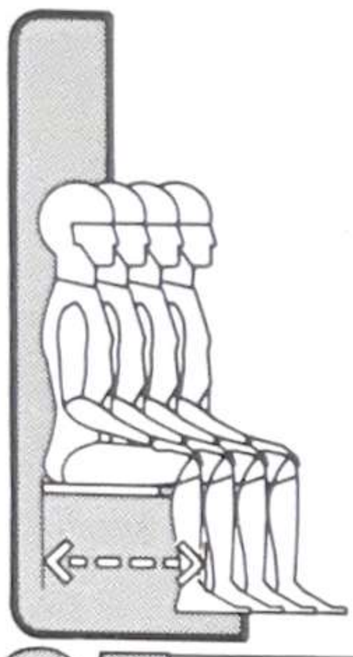


7I

BUTTOCK-POPLITEAL LENGTH

Buttock-Popliteal Length of Children in Inches and Centimeters by Age, Sex, and Selected Percentiles

		6 Years		7 Years		8 Years		9 Years		10 Years		11 Years	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95	**BOYS**	**14.7**	**37.4**	**15.3**	**38.9**	**16.6**	**42.2**	**17.7**	**45.0**	**18.3**	**46.5**	**19.0**	**48.3**
	GIRLS	**15.2**	**38.6**	**15.9**	**40.3**	**17.0**	**43.1**	**17.8**	**45.2**	**18.8**	**47.7**	**19.9**	**50.5**
90	BOYS	14.1	35.7	15.0	38.0	15.8	40.1	16.8	42.7	17.4	44.3	18.3	46.4
	GIRLS	14.6	37.0	15.2	38.5	16.2	41.1	17.2	43.8	18.0	45.8	19.2	48.7
75	BOYS	13.3	33.7	14.1	35.7	14.9	37.8	15.7	39.9	16.5	41.9	17.2	43.7
	GIRLS	13.5	34.4	14.4	36.5	15.2	38.6	16.2	41.2	17.2	43.6	18.0	45.7
50	BOYS	12.6	31.9	13.3	33.8	14.1	35.8	15.0	38.2	15.6	39.7	16.4	41.7
	GIRLS	12.8	32.6	13.6	34.6	14.4	36.6	15.3	38.9	16.2	41.2	17.0	43.1
25	BOYS	12.0	30.4	12.8	32.4	13.5	34.3	14.3	36.3	14.9	37.8	15.6	39.7
	GIRLS	12.2	31.1	13.0	32.8	13.8	35.1	14.6	37.2	15.4	39.1	16.1	40.9
10	BOYS	11.5	29.3	12.3	31.2	13.0	33.1	13.7	34.7	14.3	36.2	15.0	38.2
	GIRLS	11.7	29.7	12.4	31.6	13.2	33.5	13.9	35.4	14.6	37.0	15.4	39.2
5	**BOYS**	**11.3**	**28.6**	**12.0**	**30.4**	**12.7**	**32.3**	**13.4**	**34.1**	**13.9**	**35.3**	**14.5**	**36.9**
	GIRLS	**11.3**	**28.8**	**12.0**	**30.6**	**12.9**	**32.7**	**13.5**	**34.3**	**14.1**	**35.8**	**15.0**	**38.1**



7J

BUTTOCK-KNEE LENGTH

Buttock-Knee Length of Children in Inches and Centimeters by Age, Sex, and Selected Percentiles

		6 Years		7 Years		8 Years		9 Years		10 Years		11 Years	
		in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
95	**BOYS**	**16.4**	**41.6**	**17.6**	**44.6**	**18.3**	**46.5**	**19.5**	**49.5**	**20.1**	**51.0**	**21.1**	**53.7**
	GIRLS	**16.5**	**41.9**	**17.5**	**44.4**	**18.7**	**47.6**	**19.9**	**50.5**	**20.7**	**52.7**	**22.0**	**55.9**
90	BOYS	16.1	40.8	17.1	43.4	17.9	45.4	18.9	47.9	19.7	50.1	20.7	52.5
	GIRLS	16.2	41.2	17.1	43.5	18.3	46.4	19.4	49.4	20.2	51.4	21.6	54.8
75	BOYS	15.4	39.1	16.4	41.6	17.2	43.8	18.2	46.2	19.0	48.2	19.9	50.5
	GIRLS	15.6	39.6	16.5	41.9	17.5	44.5	18.6	47.3	19.5	49.5	20.5	52.1
50	BOYS	14.7	37.4	15.7	39.9	16.5	41.8	17.4	44.2	18.2	46.3	19.0	48.3
	GIRLS	14.9	37.9	15.8	40.1	16.7	42.5	17.6	44.7	18.6	47.3	19.5	49.5
25	BOYS	14.1	35.7	15.0	38.1	15.8	40.2	16.5	41.9	17.4	44.2	18.2	46.2
	GIRLS	14.2	36.1	15.0	38.2	15.9	40.5	16.8	42.6	17.6	44.7	18.6	47.3
10	BOYS	13.2	33.6	14.2	36.1	14.8	37.6	15.6	39.7	16.3	41.5	17.4	44.1
	GIRLS	13.2	33.5	14.1	35.7	15.2	38.6	15.9	40.4	16.7	42.3	17.8	45.2
5	**BOYS**	**12.4**	**31.5**	**13.3**	**33.7**	**14.1**	**35.7**	**14.8**	**37.7**	**15.7**	**39.8**	**16.6**	**42.2**
	GIRLS	**12.7**	**32.2**	**13.5**	**34.2**	**14.6**	**37.1**	**15.2**	**38.6**	**15.9**	**40.5**	**17.2**	**43.7**

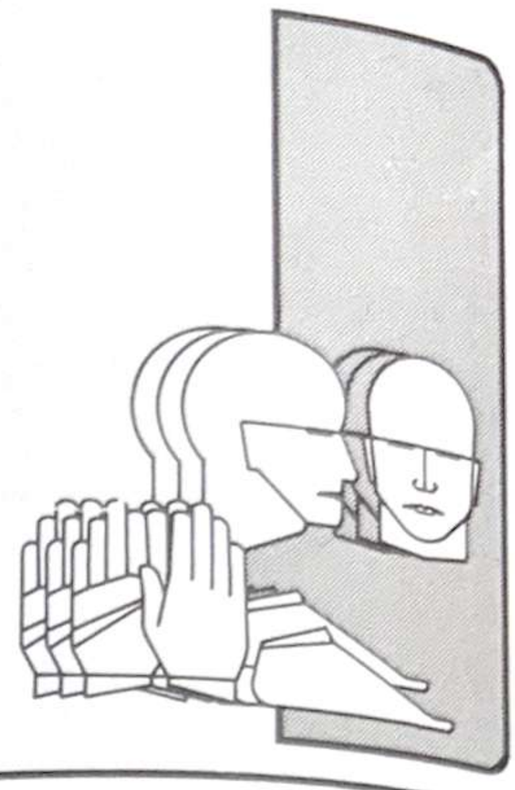
8 MALE HEAD, FACE HAND, AND FOOT DIMENSIONS

DESCRIPTION

The table provides 5th and 95th percentile dimensions of the male head, face, hand, and foot. Although of greater value to the designer of clothing and equipment, the hand and foot dimensions could also prove quite useful to the architect and interior designer. Applications would include security grilles, gratings, access and vision panels, recreational equipment, commercial or residential shoe storage arrangements and devices, and special spaces for physically disabled people. Proper allowances for clothing and shoes should be added to all data.

SOURCE

Human Factors Engineering, 3d ed., AFSC Design Handbook 1-31 January 1977, Department of the Air Force, Headquarters Air Force Systems Command Andrews AFB, DC 20334, p. 6.



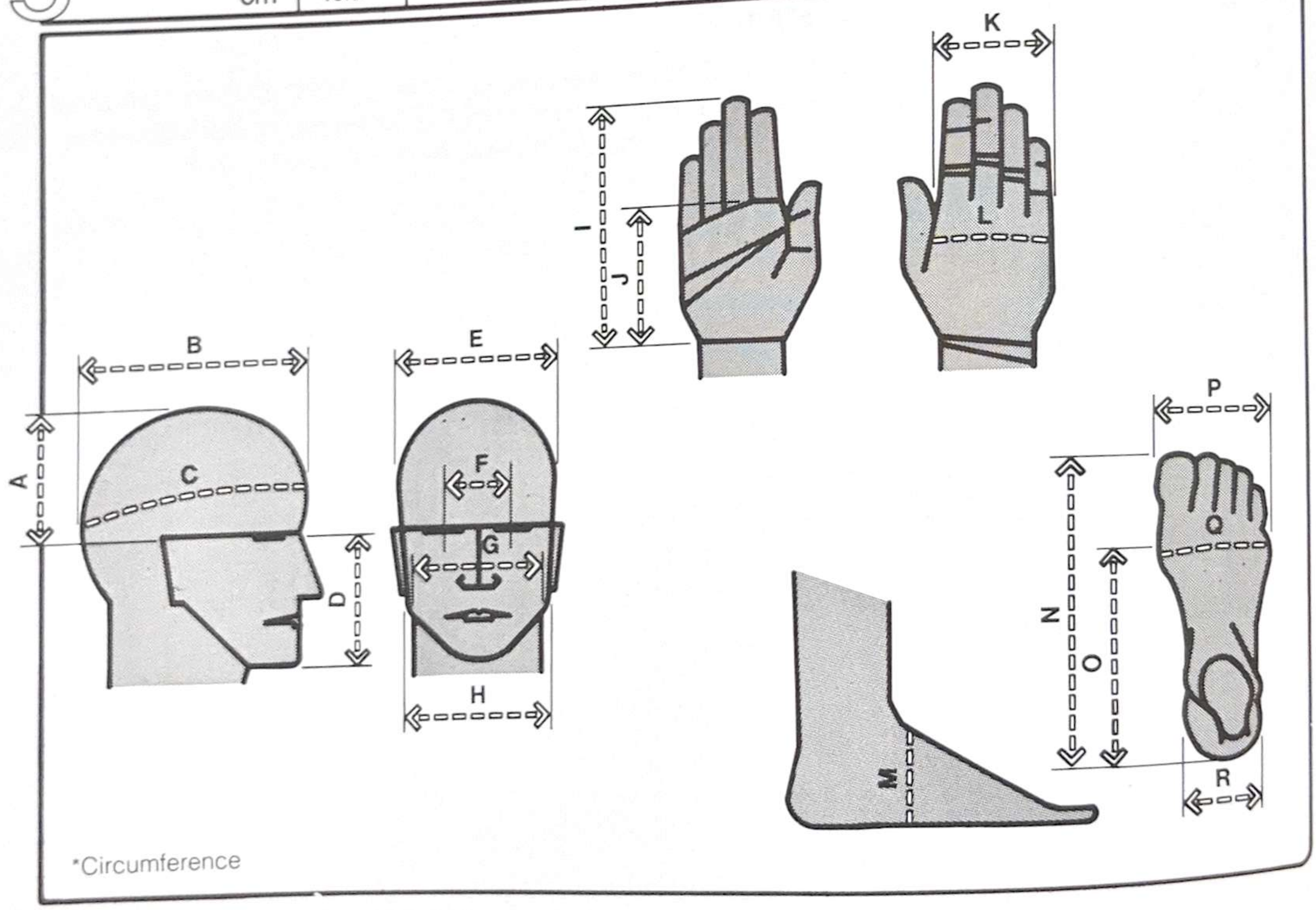
8

HEAD, FACE, HAND, AND FOOT DIMENSIONS

Adult Male Head, Face, Hand, and Foot Dimensions in Inches and Centimeters and by Selected Percentiles

		A	B	C*	D	E	F	G	H	I
95	in	5.0	6.50	23.59	5.13	8.27	2.71	5.94	5.98	8.07
	cm	12.7	16.5	59.9	13.0	21.0	6.9	15.1	15.2	20.5
5	in	4.1	5.80	21.74	4.35	7.39	2.24	5.27	5.26	7.00
	cm	10.4	14.7	55.2	11.0	18.8	5.7	13.4	13.4	17.8

		J	K	L*	M*	N	O	P	Q*	R
95	in	4.63	3.78	9.11	10.95	11.44	8.42	4.18	10.62	2.87
	cm	11.8	9.6	23.1	27.8	29.1	21.4	10.6	27.0	7.3
5	in	3.92	3.24	7.89	9.38	9.89	7.18	3.54	9.02	2.40
	cm	10.0	8.2	20.0	23.8	25.1	18.2	9.0	22.9	6.1



*Circumference

9 JOINT MOTION

DESCRIPTION

The study, measurement, and evaluation of the ranges of joint motion is a complex and relatively sophisticated science. Measuring techniques have not been completely perfected and some yet remain to be devised. Research with respect to certain aspects of the dynamics involved, particularly in terms of the interaction of two or more joints or muscles, is still in its early stages. The data available are scarce, and information specifically related to large samplings of the civilian population practically nonexistent. Table 9 includes what information is available concerning ranges of joint motion relative to the neck, spine, shoulder, elbow, hip, knee, wrist, fingers, ankle, and foot. Most of the data, however, are based on a military population and are concerned primarily with the simple movement of a single joint and not with the effect of one upon the other. Proper allowances for clothing and shoes should be added to all data.

SOURCE

Human Factors Engineering, 3d ed., AFSC Design Handbook 1-3, January 1977, Department of the Air Force, Headquarters Air Force Systems Command, Andrews AFB, DC 20334, pp. 16–17.

JOINT MOTION TERMINOLOGY[1]

Flexion: bending or decreasing the angle between the parts of the body. Supplementing the more commonly measured arm and leg flexions, several kinds of flexion have been identified to meet special descriptive needs. These are *trunk lateral* flexion in which the trunk segments move so as to decrease the angle between them and the right thigh; *radial* flexion, which refers to the movement of the thumb side of the hand toward the radial side of the forearm segments; and *ulnar* flexion, which refers to the opposite side of the hand's movement toward the ulnar side of the forearm segment.

Extension: straightening or increasing the angle between the parts of the body. It is generally defined as the return from flexion. When a joint is extended beyond the normal range of its movement, the movement becomes known as "hyperextension."

Abduction: movement of a body segment away from the midline of the body or body part to which it is attached.

Adduction: movement of a body segment or segment combination toward the midline of the body or body part to which it is attached.

Medial rotation: turning toward the midline of the body.

Lateral rotation: turning away from the midline of the body.

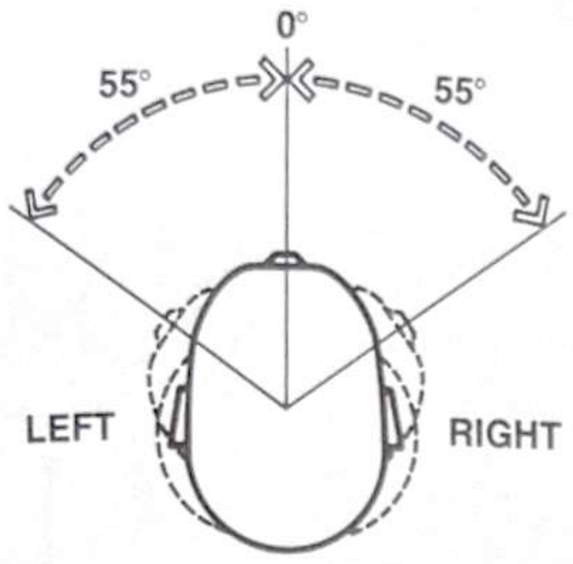
Pronation: rotating the forearm so that the palm faces downward.

Supination: rotating the forearm so that the palm faces upward.

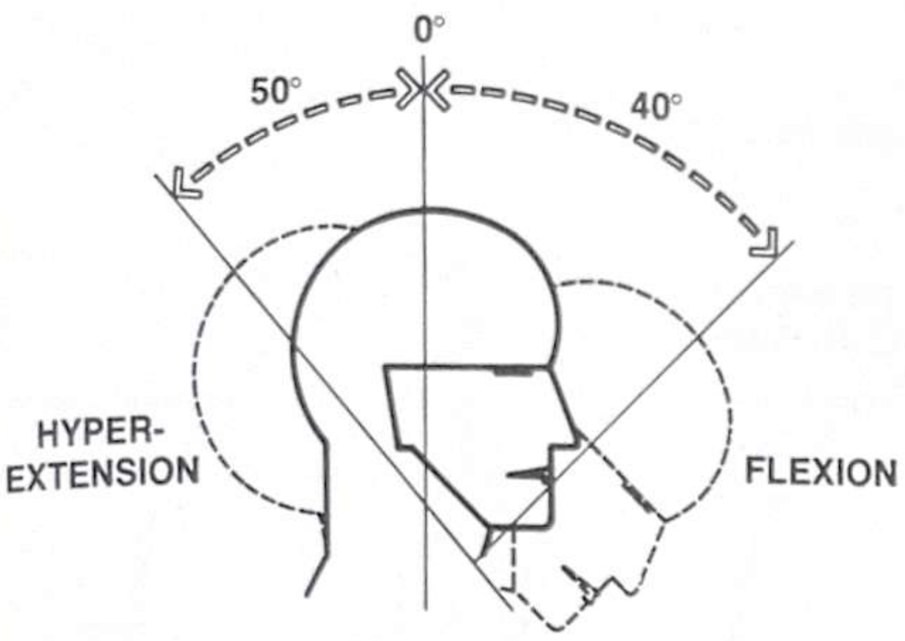
Eversion: rotation of the foot which lifts its lateral border to turn the sole or plantar surface outward.

Inversion: lifting the medial border of the foot to turn the sole inward.

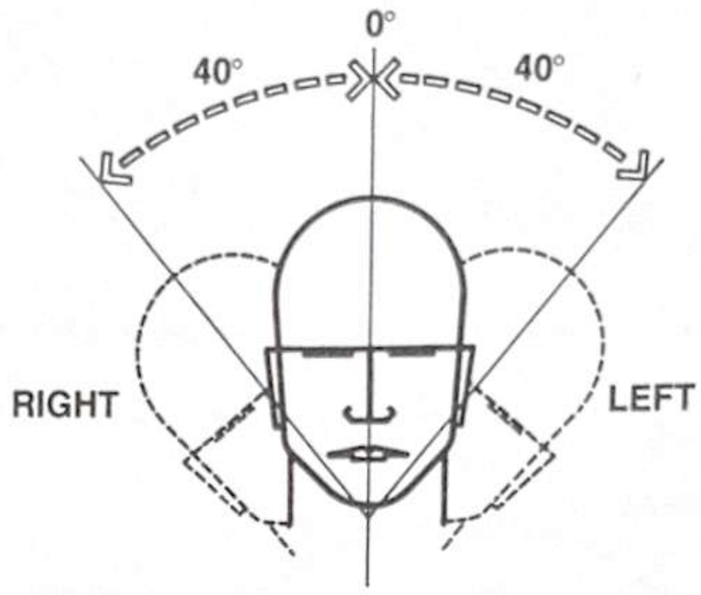
NECK



ROTATION



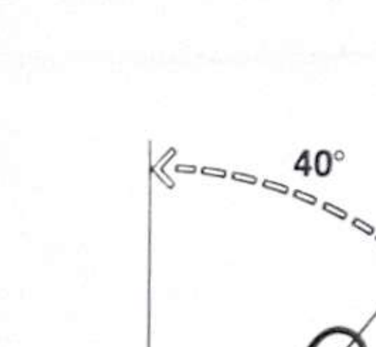
HYPEREXTENSION AND FLEXION



LATERAL BENDING

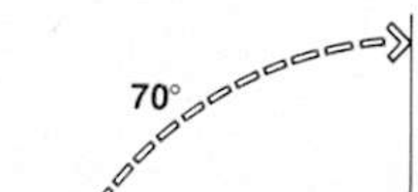
JOINT MOTION

SPINE

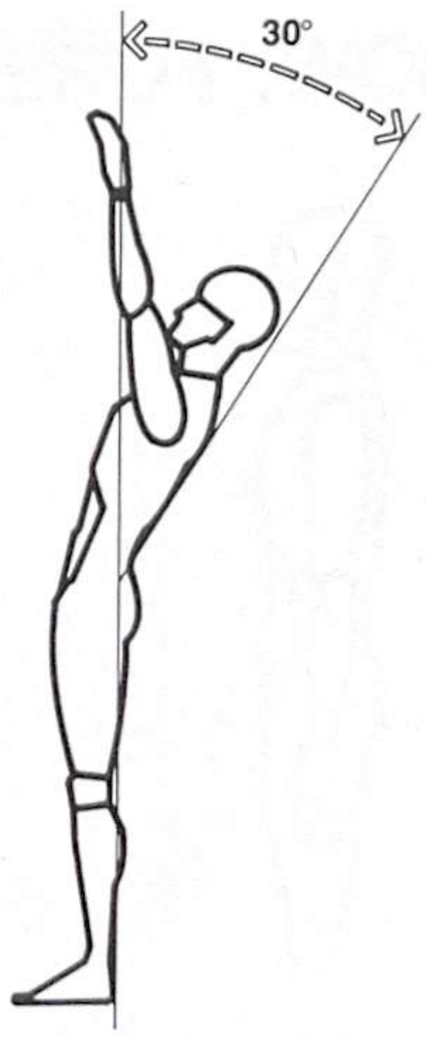


LATERAL BENDING

ROTATION



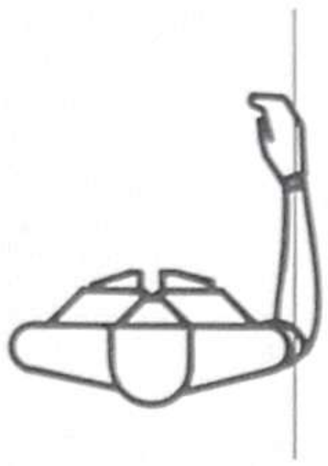
FLEXION



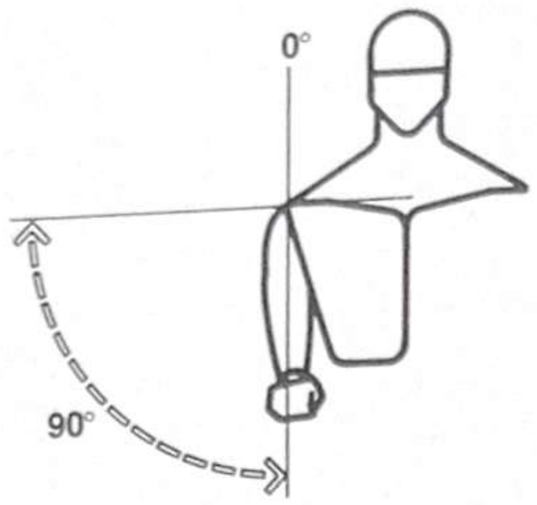
HYPEREXTENSION

JOINT MOTION

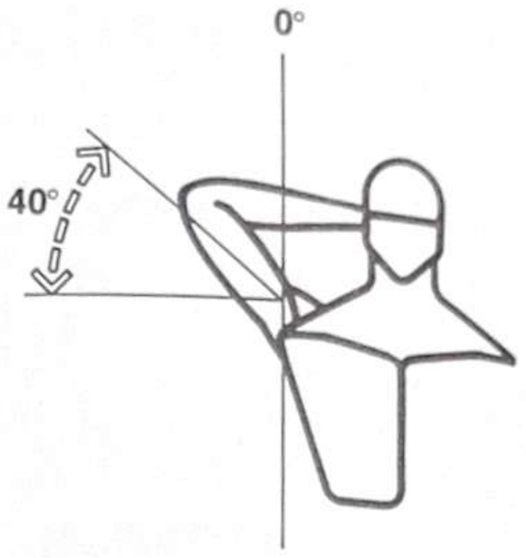
SHOULDER



NEUTRAL

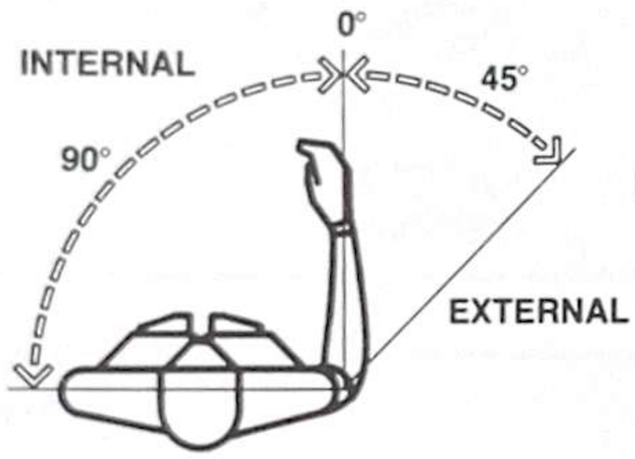


ABDUCTION

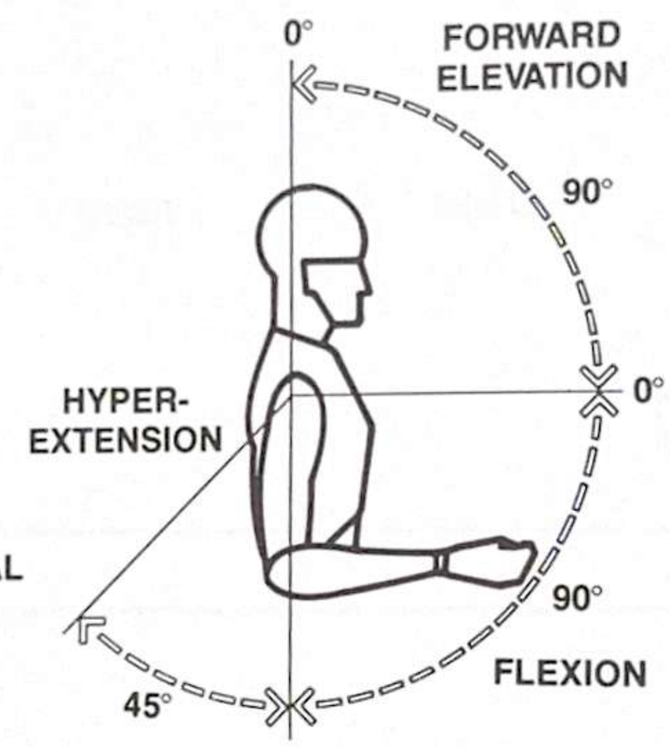


ELEVATION

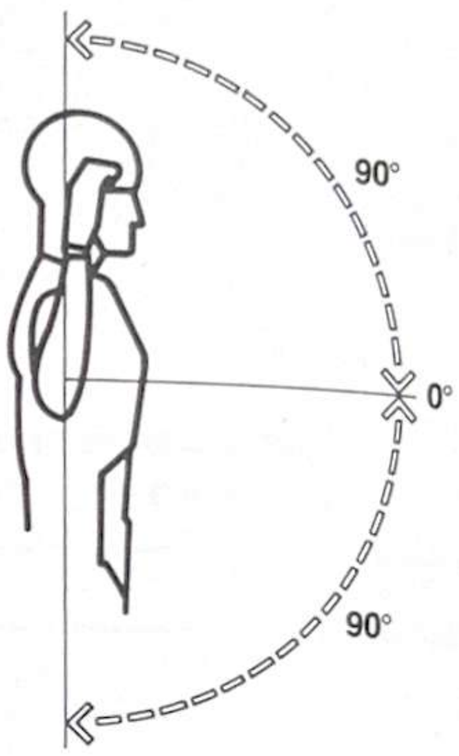
JOINT MOTION



ROTATION IN NEUTRAL POSITION



HYPEREXTENSION AND FLEXION



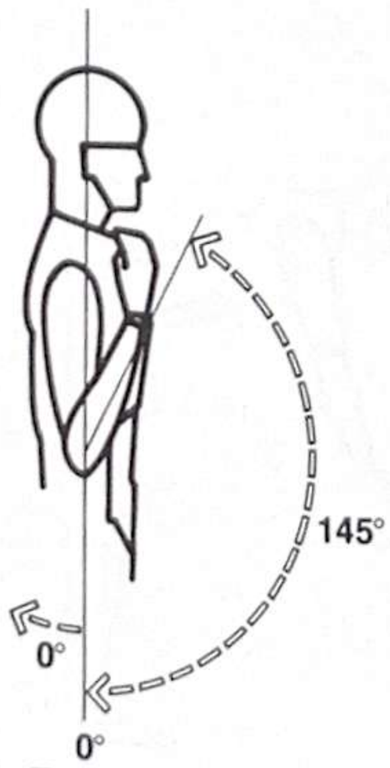
ROTATION IN ABDUCTION

ELBOW / FOREARM

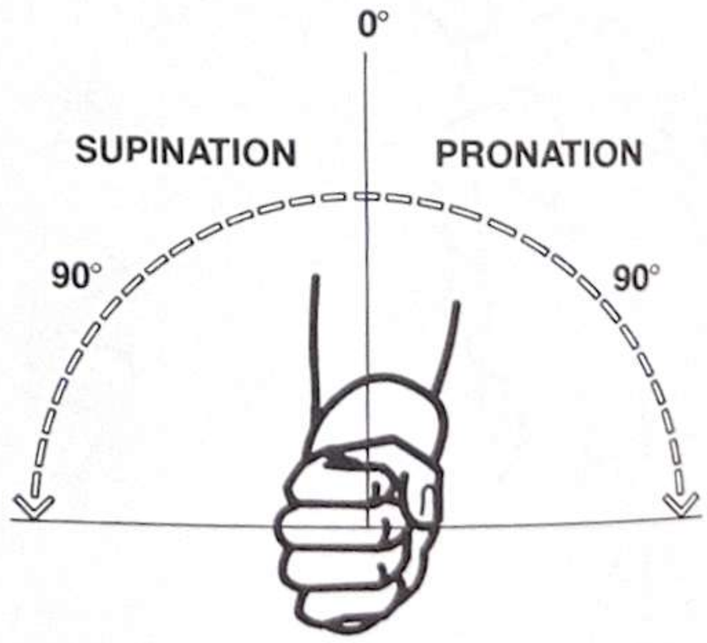
JOINT MOTION



NEUTRAL EXTENSION

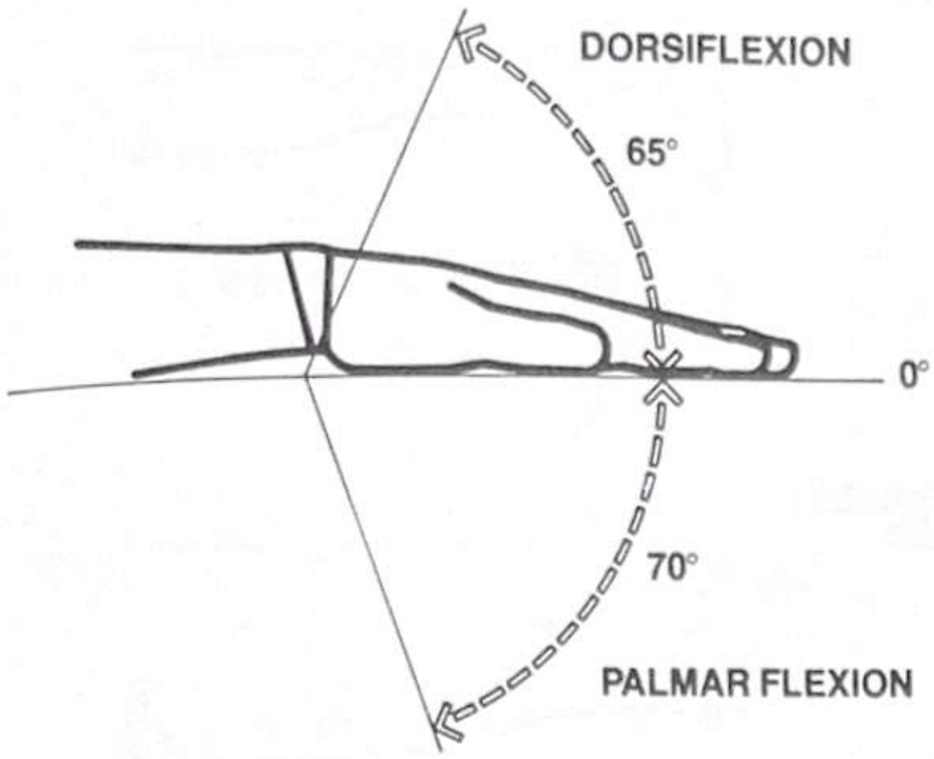


FLEXION

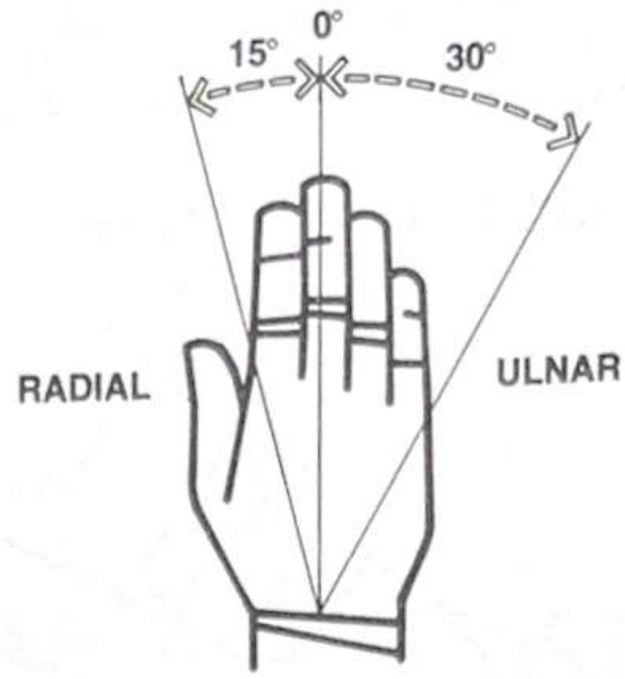


PRONATION AND SUPINATION

WRIST



FLEXION AND EXTENSION



DEVIATION

JOINT MOTION

FINGERS



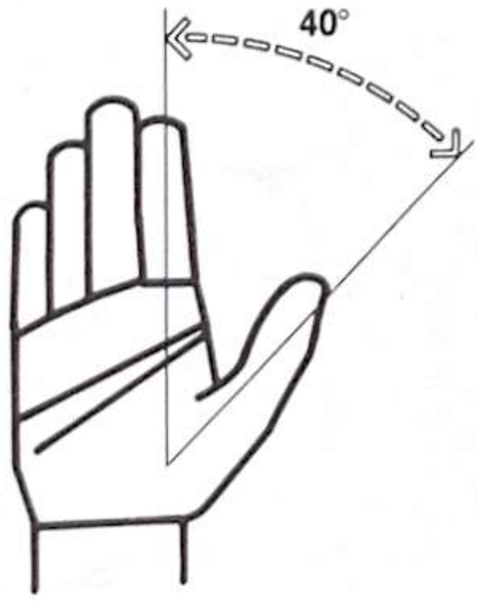
NEUTRAL



HYPEREXTENSION



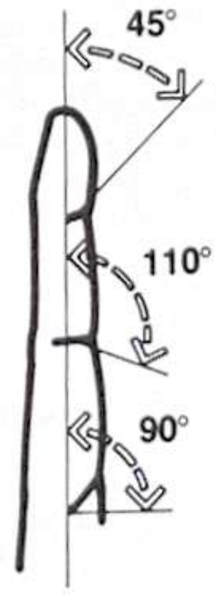
NEUTRAL



ABDUCTION



OPPOSITION

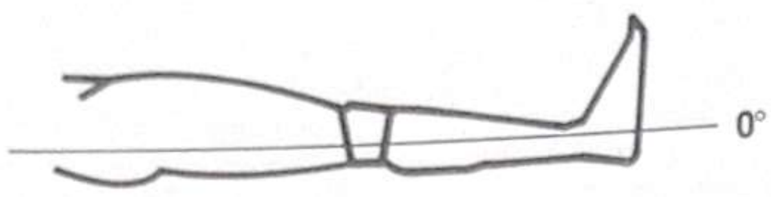


FLEXION

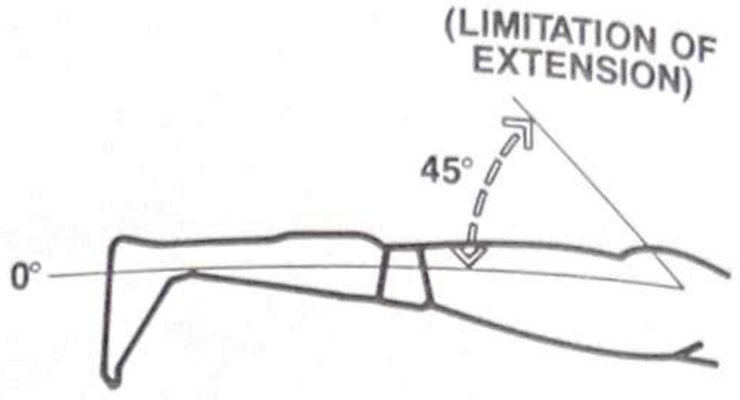
JOINT MOTION

JOINT MOTION

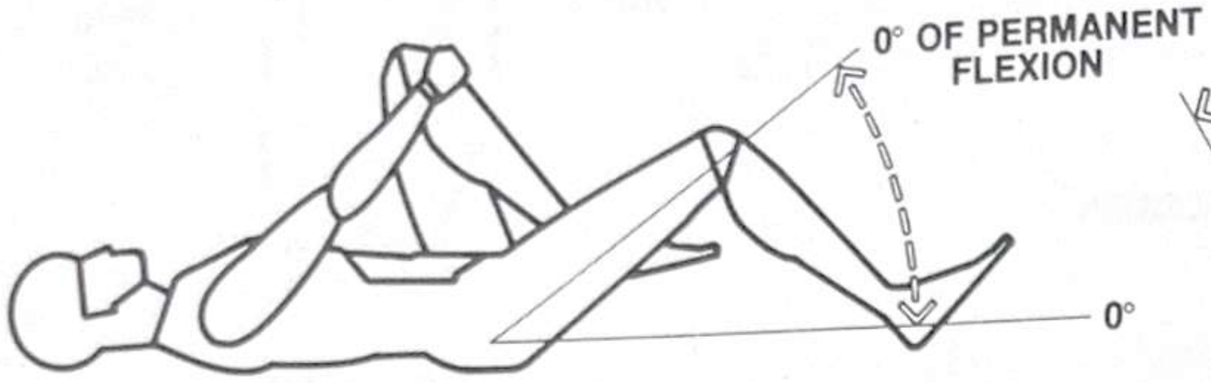
HIP



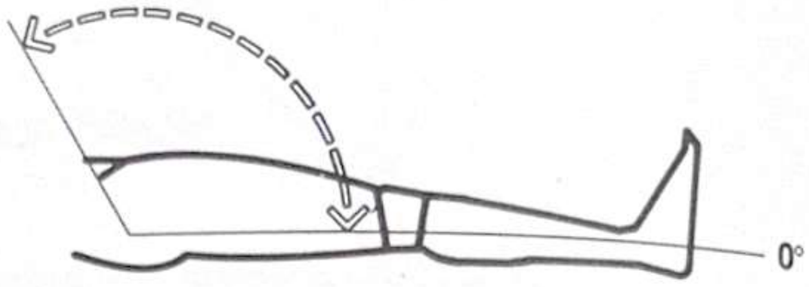
NEUTRAL EXTENSION



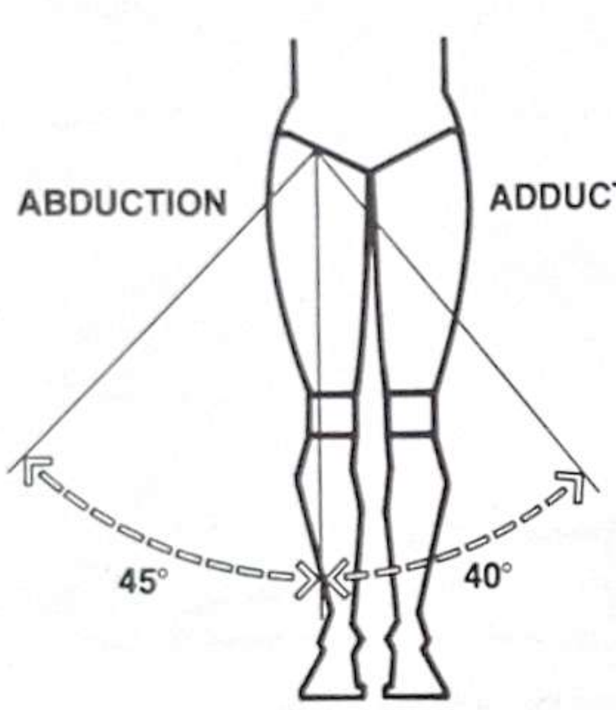
HYPEREXTENSION



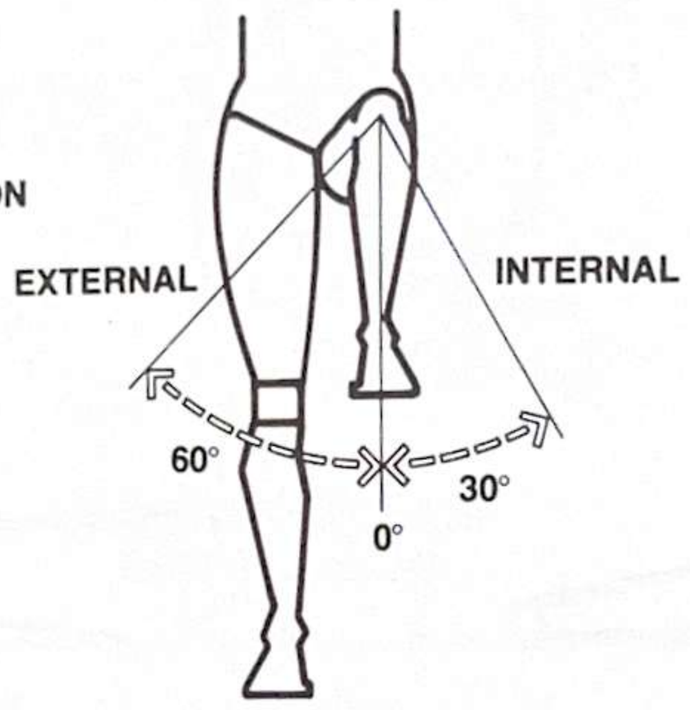
PERMANENT FLEXION



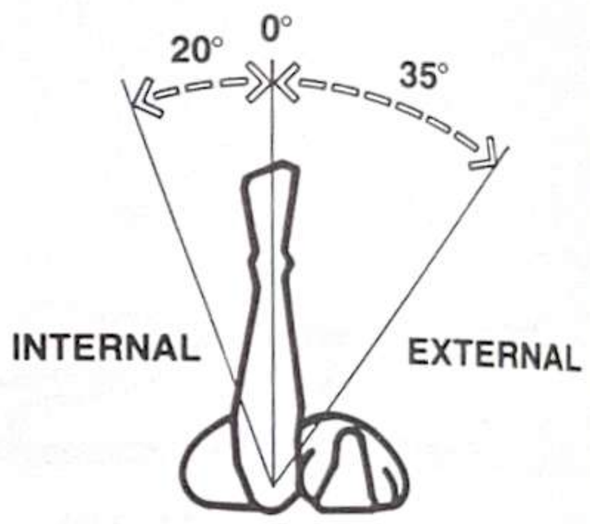
FLEXION



ABDUCTION AND ADDUCTION



ROTATION IN FLEXION

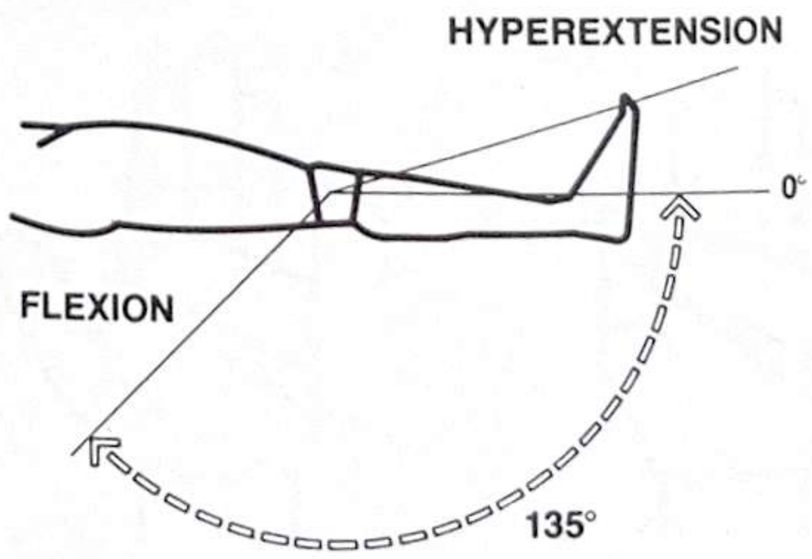


ROTATION IN EXTENSION

KNEE

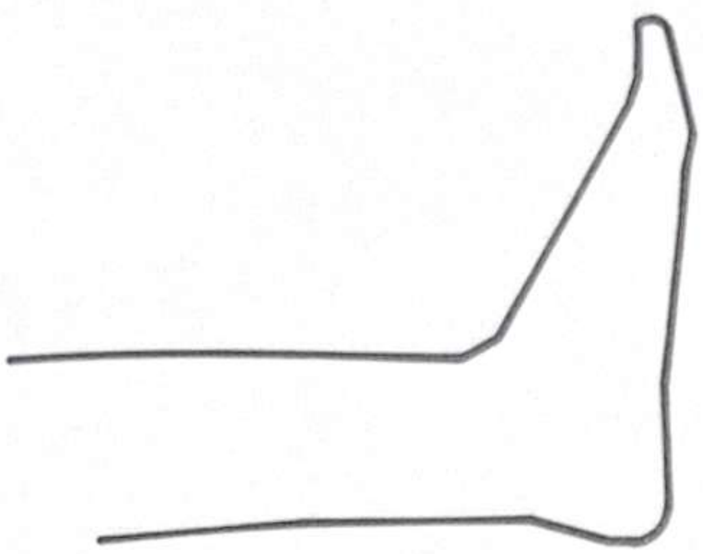


NEUTRAL EXTENSION

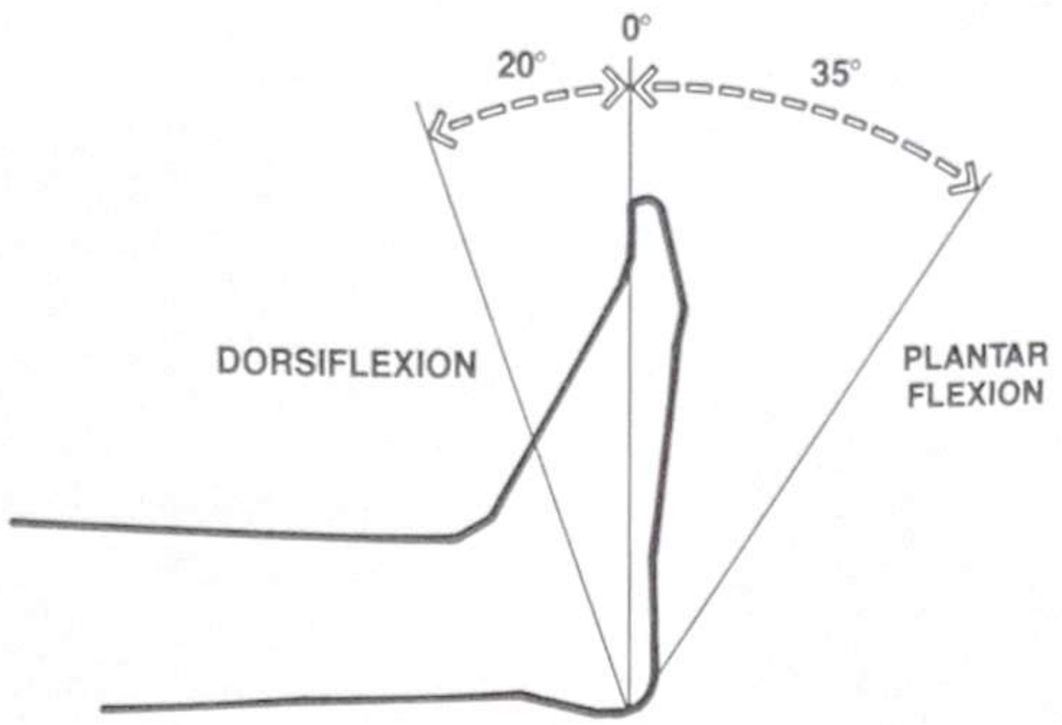


HYPEREXTENSION AND FLEXION

ANKLE



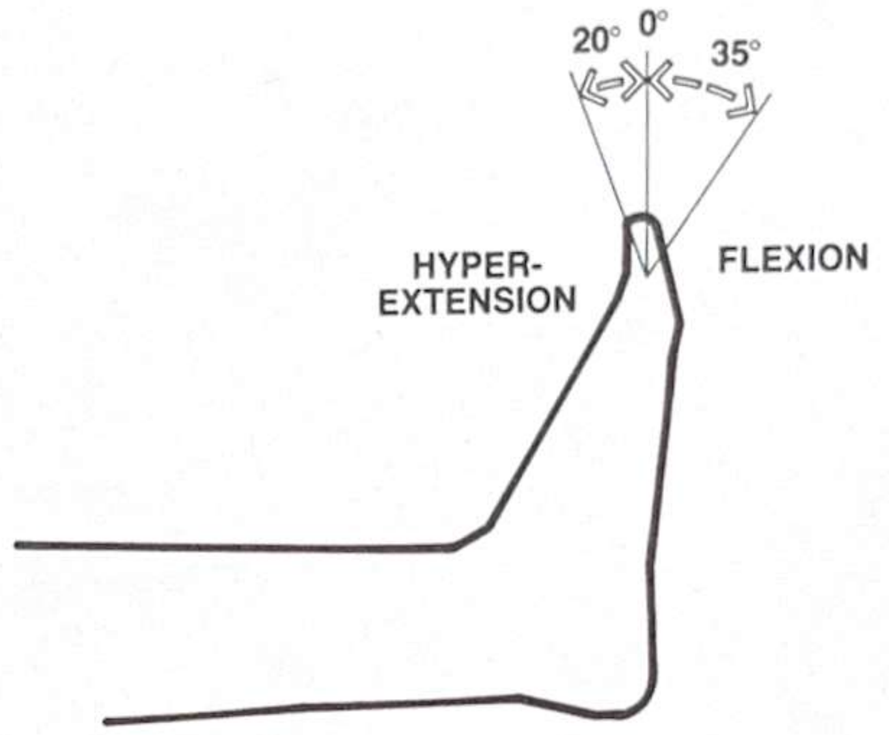
NEUTRAL



DORSIFLEXION AND PLANTAR FLEXION

JOINT MOTION

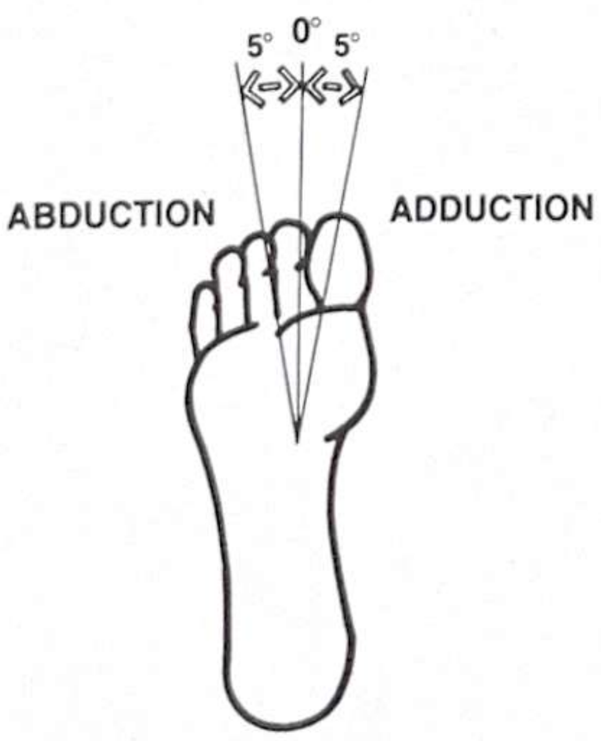
FOOT



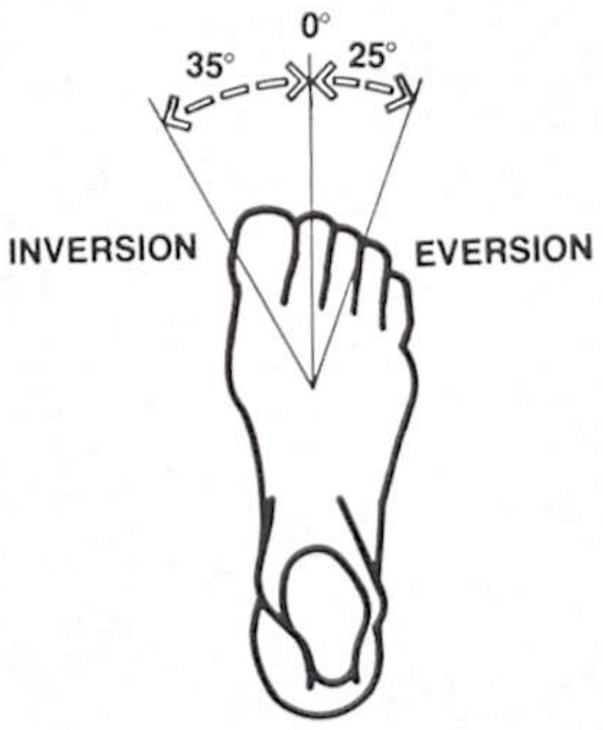
METATARSOPHALANGEAL



NEUTRAL



MIDTARSAL



SUBTALAR

JOINT MOTION

C INTERIOR SPACE/

BASIC DESIGN REFERENCE STANDARDS

The promise of easy answers associated with packaged solutions, rules of thumb, standards, and other presumably painless and time-saving devices is understandably an appealing one. In certain situations, reliance on such sources may be perfectly appropriate. In problems dealing with such human factors as the interface between the human body and the designed environment, however, the use of such sources should be discouraged. The great variety of body sizes and dimensions to be contended with and the almost infinite number of interface scenarios possible make reliance on such sources sometimes dangerous, often inappropriate, and usually unwise. In those instances where so-called standards or rules of thumb may, in fact, be appropriate, it is still more useful to understand the underlying concepts, process, and rationale than to unquestioningly apply them with only the end results in mind.

INTENT

In anticipation that the term "design reference standards," the title given to this section, should in any way be misconstrued to suggest the promise of a handbook of ready-made design solutions, it is necessary that the purpose of this section be made clear. It is definitely not intended that the drawings on the following pages be viewed as design solutions. They should serve simply as models or reference standards in the development of a more anthropometrically based approach to preliminary design, especially in areas involving the interface between the human body and various design components of interior space. The two areas of interface most commonly encountered in the average interior design or architectural practice and the two explored in this book are essentially of a physical and a visual nature. The physical usually involves problems of clearance and reach. The visual involves the field of vision in both the horizontal and the vertical planes. Both are a function, directly or indirectly, of human dimension and the range of joint motion. To intelligently resolve these problems, the designer needs some basic knowledge of anthropometry, in terms of both theory and application and an available data bank of body sizes and dimensions. The former was the subject of Part A, the latter the subject of Part B.

THE DRAWINGS

The drawings that follow identify various classic problems of interface commonly encountered in the design of certain prototypical interior spaces. By referring to the particular illustrations and the accompanying drawing text, the designer will be able to undertake his or her own individual analysis of any problem involving human dimension and the quality of interface. To more clearly explain the logic involved and to underscore the anthropometric aspect of the process, it should be noted that each drawing contains certain dimensional arrows drawn in solid line with code numbers written above. The numbers represent certain standard body measurements.

THE MATRICES

The legend for translating these numbers into particular anthropometric measurements is contained both in the master matrix at the beginning of each section and in the matrix at the beginning of each subsection. The dimension line indicates where the measurement is taken. The following observations should make the use of the matrix easier. One column lists the 24 body measurements. The other column lists the various types of interior spaces. The circular symbols indicate those specific measurements that are most significant in the design of a particular space type. The darkened circles signify that the measurement should be of the person having a larger body size. The circles shown in outline indicate that the measurement should be of a person having a smaller body size. The half darkened circles suggest that both large and small body size data be considered. The extended arrows identify the tables in Part B in which the related body measurements can be found. The matrix at the beginning of each subsection lists only those measurements relevant to that subsection. The other column lists the basic activities involved, while the symbols indicate those specific measurements most relevant to a particular activity.

THE CHARTS

The arrows shown in broken line, with a letter above, indicate other dimensional criteria that have been determined in order to comfortably accommodate the designated body measurements. The charts on each page are keyed to the letters and show the dimensions in both English and metric systems.

Through the careful use of these drawings, tables, matrices, charts, and text as a model, the designer of interior space should be able to establish the dimensional requirements necessary to respond to the anthropometric demands inherent in any type of interface situation that includes the human body and that space. Preliminary design assumptions so developed are sure to be far more responsive to human dimension than arbitrary or often outdated standards or rules of thumb.

1 SEATING

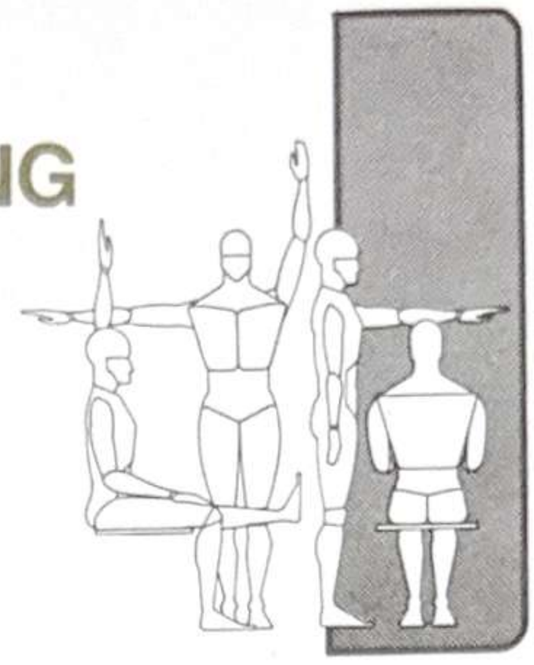
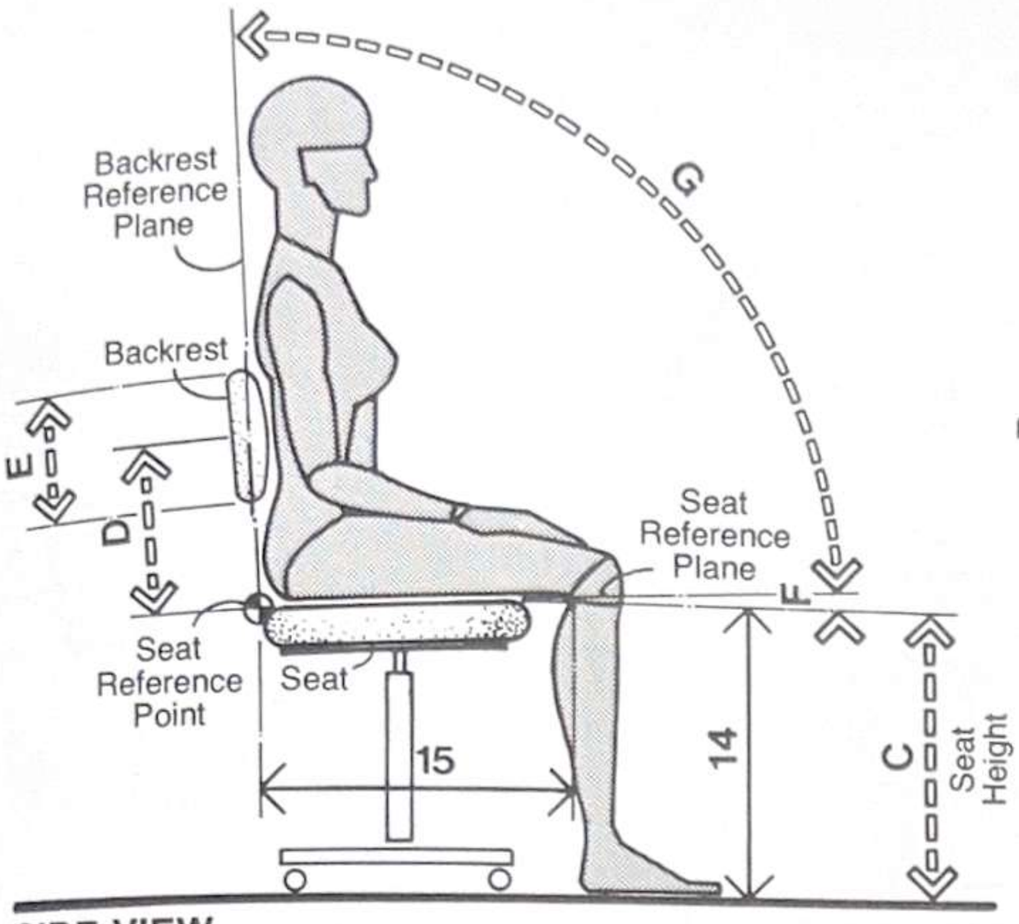


TABLE	SEATING TYPES						ANTHROPOMETRIC DATA
	WORK	GENERAL PURPOSE	EXECUTIVE	EASY CHAIR	DRAFTING	BANQUETTE	
							1 STATURE
							2 EYE HEIGHT
							3 ELBOW HEIGHT
							4 SITTING HEIGHT ERECT
							5 SITTING HEIGHT NORMAL
							6 EYE HEIGHT SITTING
							7 MIDSHOULDER HEIGHT SITTING
							8 SHOULDER BREADTH
							9 ELBOW-TO-ELBOW BREADTH
1J,2F			◪	◪			10 HIP BREADTH
1K,2G			◪	◪			11 ELBOW REST HEIGHT
							12 THIGH CLEARANCE
							13 KNEE HEIGHT
1N,2J	◪	◪	◪	◪	◪	◪	14 POPLITEAL HEIGHT
1O,2K	◪	◪	◪	◪	◪	◪	15 BUTTOCK-POPLITEAL LENGTH
1P,2L					◪		16 BUTTOCK-KNEE LENGTH
							17 BUTTOCK-TOE LENGTH
1R,4B			◪				18 BUTTOCK-HEEL LENGTH
							19 VERTICAL REACH HEIGHT SITTING
							20 VERTICAL GRIP REACH
							21 SIDE ARM REACH
							22 THUMB TIP REACH
							23 MAXIMUM BODY DEPTH
1X,6A			◪	◪	◪	◪	24 MAXIMUM BODY BREADTH

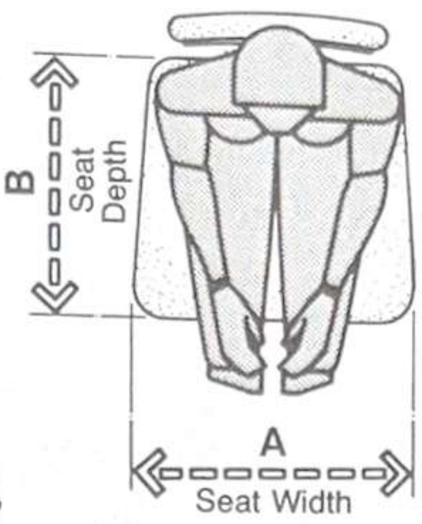
The design of seating, more than any other element of interior space, involves the elusive quality of user comfort. Since relatively little research in this area has been undertaken, conflicting recommendations abound for many of the dimensions involved. The measurements indicated in the drawings on the following pages, therefore, reflect basic anthropometric requirements and, within reasonable parameters, generally accepted notions of comfort. The intent of the diagrams is to indicate some of the more basic critical dimensional requirements necessary to ensure a reasonable interface between the human body and the seat and to establish an intelligent point of departure for the design process. Part of this process, it should be noted, involves the fabrication of full-size mockups and prototypes, whereby function, esthetics, and user comfort can be properly evaluated and design modifications made accordingly.

In many instances, seating is directly related to a table, desk, counter, or a variety of special worksurfaces. However, the diagrams in this section deal exclusively with the seat itself. The proper relationship between the seat and other elements is included in those other sections appropriate to the activity involved. For example, the desk/chair relationship is included in Section 3 dealing with office spaces; situations involving visibility and lines of sight from a seated position are covered in the section on the design of audiovisual spaces. The seating types included in the diagrams are executive chairs, secretarial chairs, general purpose chairs, drafting stools, and banquettes. The critical dimensions examined include seat height, seat depth, seat width, seat angle, armrest height and spacing, and backrest dimensions and slope.

It should be noted that the dimensions shown are taken from the compressed seat padding or cushion surface. In the design of seating, the relative resiliency and compressive qualities of the cushion are therefore extremely important. Recommended seat compression allowance varies, according to the source consulted, from ½ to 2 in, or 1.3 to 5.1 cm, and is obviously a function of both the material used and the manner in which the padding is detailed. Section 4 of Part A deals in greater detail with the question of cushioning and with the general theory of seating design. This section should be consulted prior to the application of any of the recommended dimensional information shown in the following diagrams.



SIDE VIEW



PLAN VIEW

WORK OR SECRETARIAL CHAIR

CRITICAL WORK CHAIR MEASUREMENTS

SOURCE	A SEAT WIDTH		B SEAT DEPTH		C SEAT HEIGHT		D C.L. OF BACKREST HEIGHT FROM SEAT SURFACE		E BACKREST HEIGHT		F ANGLE OF TILT OF SEAT SURFACE	G ANGLE OF BACKREST
	in	cm	in	cm	in	cm	in	cm	in	cm	degrees	degrees
1 CRONEY	17	43.2	13.5-15	33.6-38.1	14-19	35.6-48.2	5-7.5	12.7-19.0	4-8	10.2-20.3	0°-5° or 3°-5°	95°-115°
2 DIFFRIENT	16 min.	40.6	15-16	38.1 40.6	13.6-20.6	34.5-52.3	9-10	22.9-25.4	6-9	15.2-22.9	0°-5°	95°
3 DREYFUSS	15	38.1	12-15	30.5-38.1	15-18	38.1-45.7	7-11	17.8-27.9	5.1-8	12.9-20.3	0°-5°	95°-105°
4 GRANDJEAN	15.75	40.0	15.75	40.0	14.9-20.8	37.8-52.8			7.9-11.8	20-30	3°-5°	Adjustable
5 PANERO-ZELNIK	17-19	43.2-48.3	15.5-16	39.4-40.6	14-20	35.6-50.8	8-10	19.2-25.4	6-9	15.2-22.9	0°-5°	95°-105°
6 WOODSON-CONOVER	15	38.1	12-15	30.5-38.1	15-18	38.1-45.7	7-10	17.8-25.4	6-8	15.24-20.32	3°-5°	20°

(1) John Croney, *Anthropometrics for Designers*, p. 147; (2) Niels Diffrient et al., *Humanscale*, Guide 2B; (3) Henry Dreyfuss, *The Measure of Man*, Sheet O, Dwg. 2; (4) Etienne Grandjean, *Ergonomics of the Home*, pp. 126, 127; (5) Authors; (6) W.E. Woodson and Donald Conover, *Human Engineering Guide for Equipment Designers*, p. 2-142 (see Selected Bibliography for additional information).

1 SEATING

The top diagram shows the more critical measurements to be considered in the design of the typical work or secretarial chair. To function properly, its design must be responsive to human dimension. Anthropometrically, the two most important measurements are buttock-popliteal length and popliteal height. Provision for support of the lumbar region by proper location of a backrest is essential for a successful design.

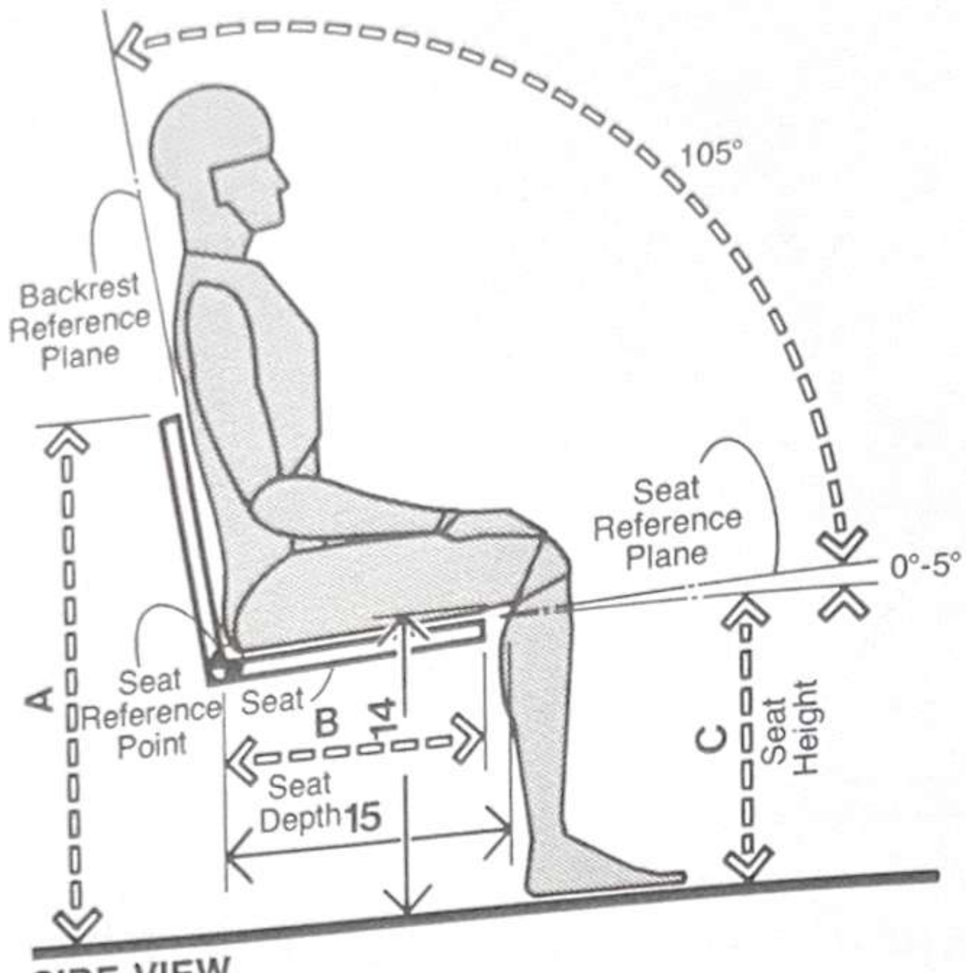
The element of sitter comfort, however, is an elusive quality that defies translation into simple dimensions. This factor alone, in addition to the considerable variation in human body size, demands the exercise of a great deal of personal judgment in establishing proper chair dimensions. Currently used recommendations may vary, but they all work and are generally responsive to anthropometric requirements. For the most part, they are also within reasonable range of each other. The authors felt it would be interesting, therefore, in addition to stating their own dimensional suggestions, to present in the form of a chart recommendations from a variety of respected sources. It should be recognized, however, that the primary intent of the data presented is to provide the designer with a basis for initial preliminary design assumptions and mockups—not a final design solution.

It is also suggested that the reader refer to Part A, Section 4, and the following pages of this section for additional information related to the theoretical aspects of chair design. A good deal of that is applicable to all chair types.

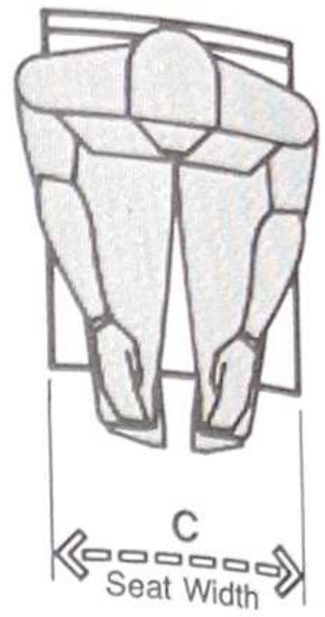
SEATING

The top diagram shows dimensions for a general purpose chair intended for brief periods of use. A 17-in, or 43.2-cm, seat height will accommodate most adults, except very small females, who may require a 16-in, or 40.6-cm, and in extreme cases, even a 14-in, or 35.6-cm, seat height. A smaller user, however, can function with a greater seat height by using a footrest.

The bottom diagram shows the dimensions for an executive chair, a type intended for a longer duration of use. The buttock-popliteal length governs the seat depth. This length, for 95 percent of both men and women, is 17-in, or 43.2-cm, or more. A seat depth not exceeding that should, therefore, accommodate a large majority of users. The very large person, however, would find that such a depth might leave a substantial portion of his thigh unsupported, while a very small person would find that the edge of the seat might dig into the tissue behind his or her knee.

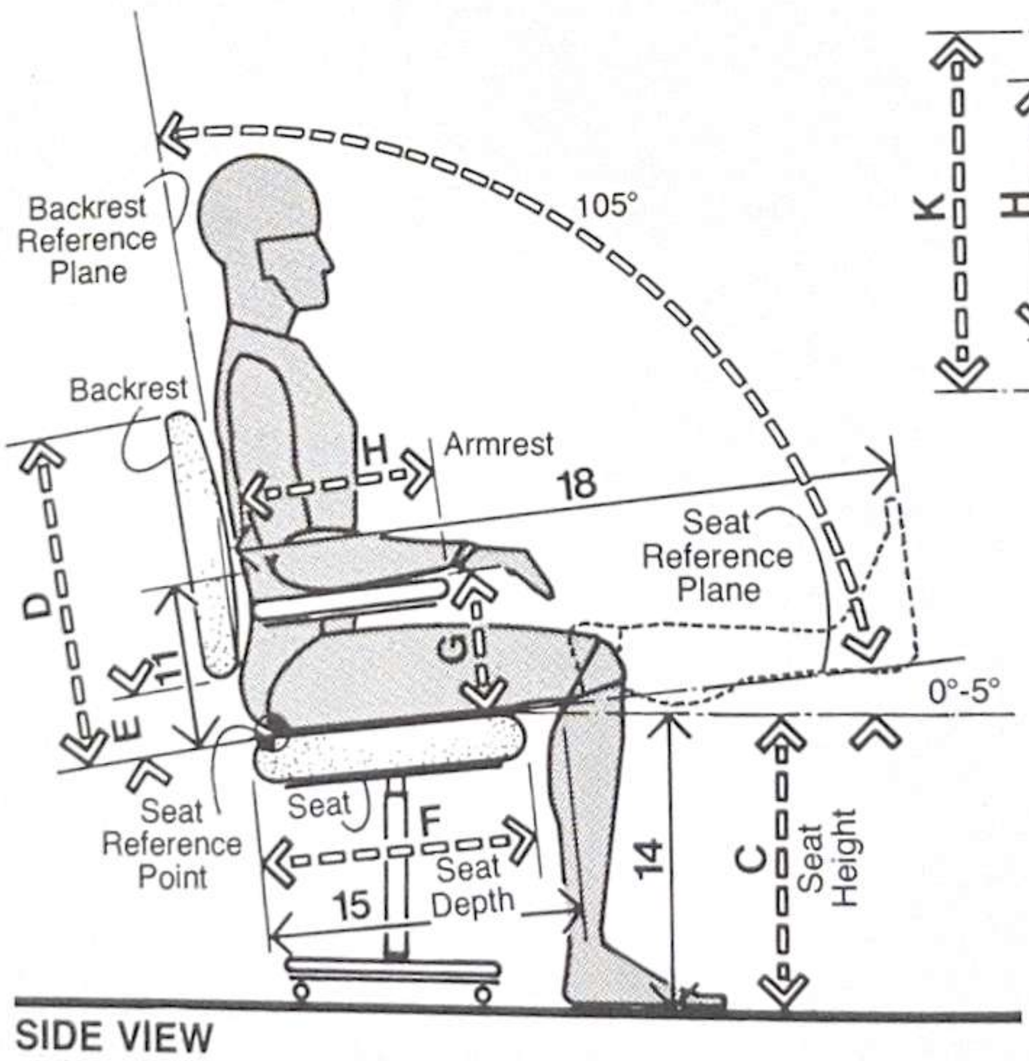


SIDE VIEW

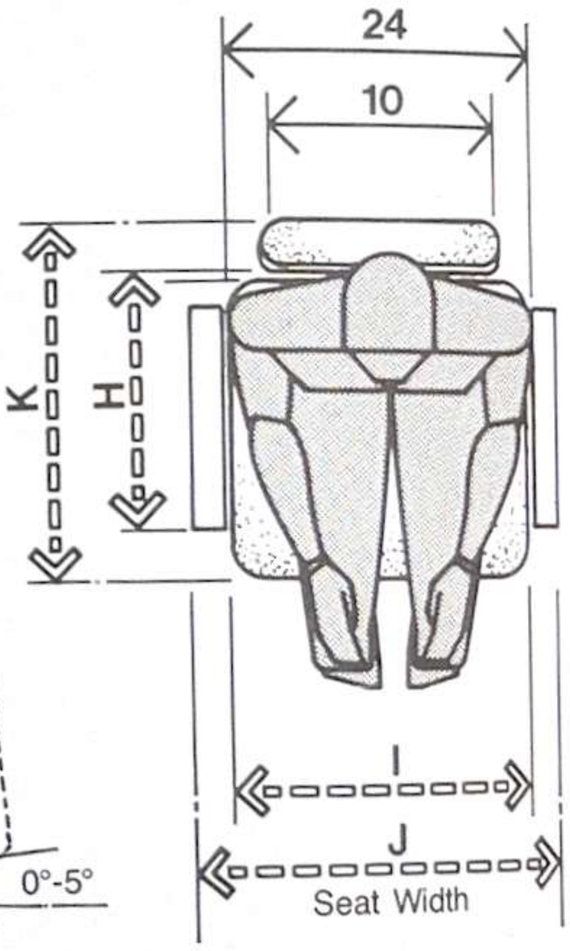


PLAN VIEW

GENERAL PURPOSE CHAIR



SIDE VIEW



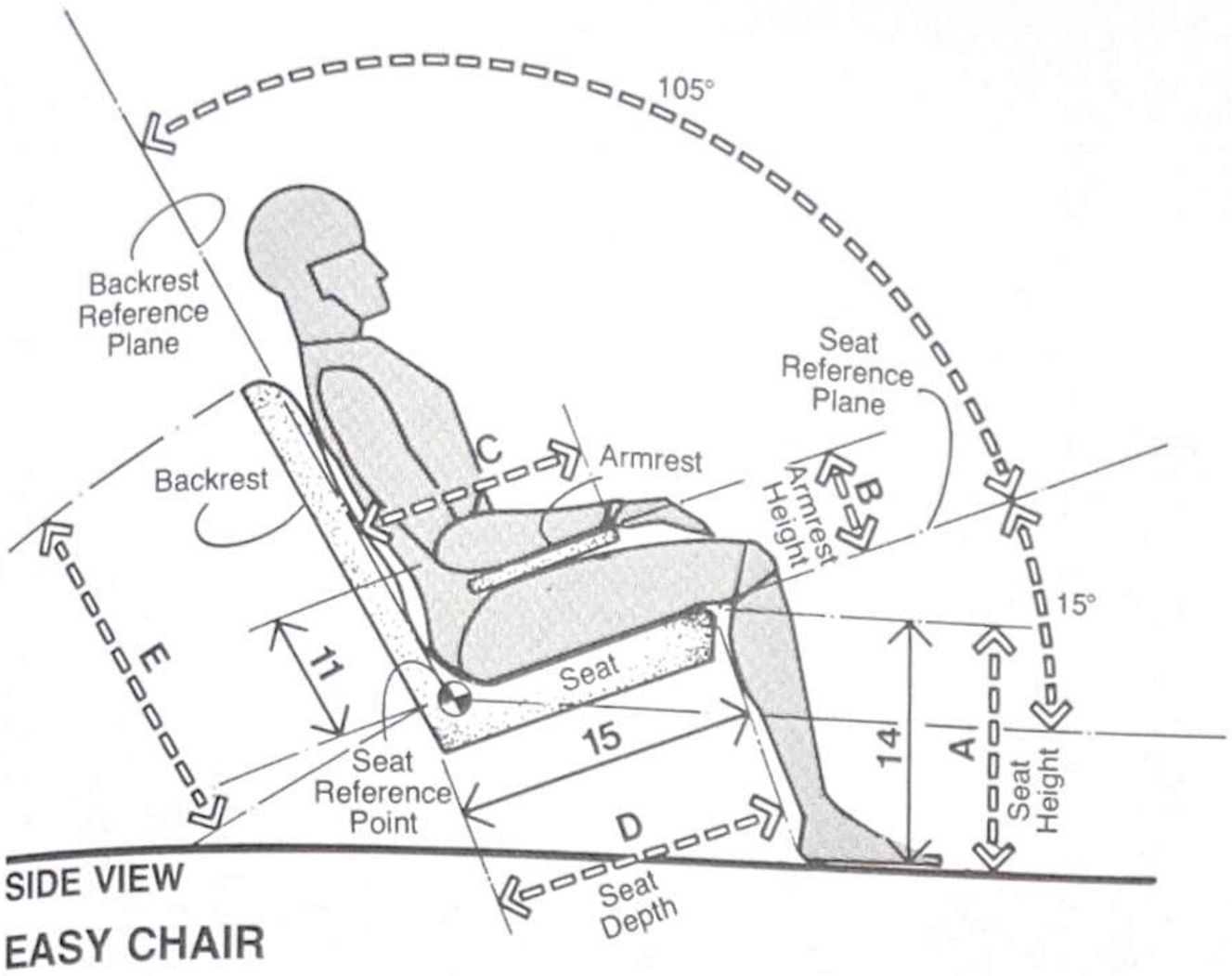
PLAN VIEW

EXECUTIVE CHAIR

	in	cm
A	31–33	78.7–83.8
B	15.5–16	39.4–40.6
C	16–17	40.6–43.2
D	17–24	43.2–61.0
E	0–6	0.0–15.2
F	15.5–18	39.4–45.7
G	8–10	20.3–25.4
H	12	30.5
I	18–20	45.7–50.8
J	24–28	61.0–71.1
K	23–29	58.4–73.7

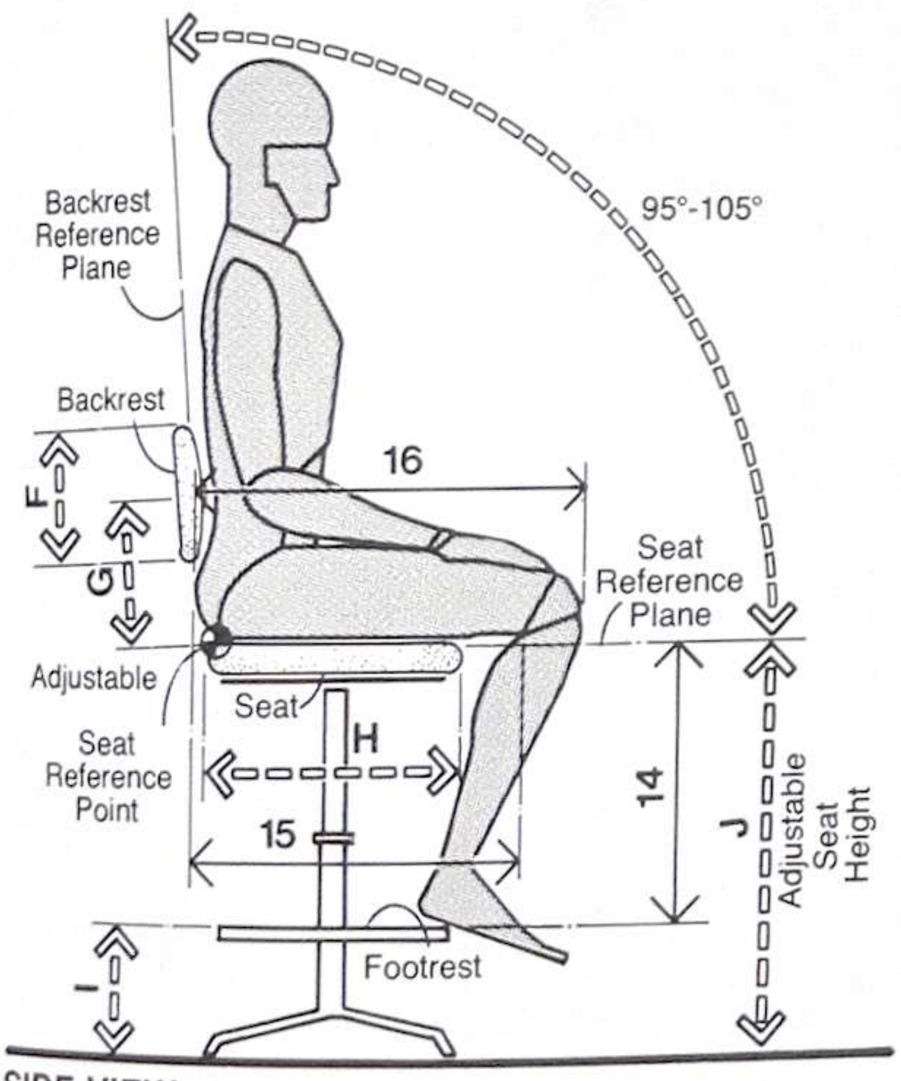
1 SEATING

The easy chair, shown in the drawing at the top, is a difficult chair type to design, or establish guidelines for, since it is primarily intended for relaxation and comfort—qualities which are highly personal. Nevertheless, the drawing offers some basic dimensions for use in making preliminary design assumptions. The following suggestions should also prove helpful: (1) The angle formed by thighs and trunk should not be less than 105°. Angles significantly less than this will cause discomfort. (2) Design should allow the user to change body posture. (3) The front edge of the seat should be rounded to prevent irritation. (4) The backrest should provide lumbar support by following the spinal contour in the lumbar region. (5) The seat surface should tilt backwards. Too severe an angle, however, may cause a person difficulty in getting up from the chair, particularly for elderly people. A seat angle of about 15° should be adequate. (6) If the angle formed by the backrest with the vertical exceeds 30°, provisions for a headrest will be required in the form of a separate design element or extension of the backrest itself. (7) Armrests should be padded and designed horizontally or at the same angle as the seat surface. The drawing at the bottom provides basic dimensional information for the design of a drafting stool, which is similar in many respects to the secretarial chair.

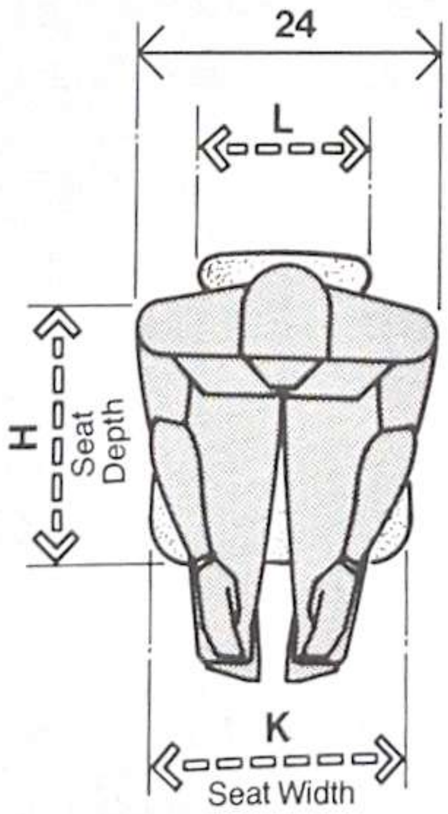


SIDE VIEW

EASY CHAIR



SIDE VIEW



PLAN VIEW

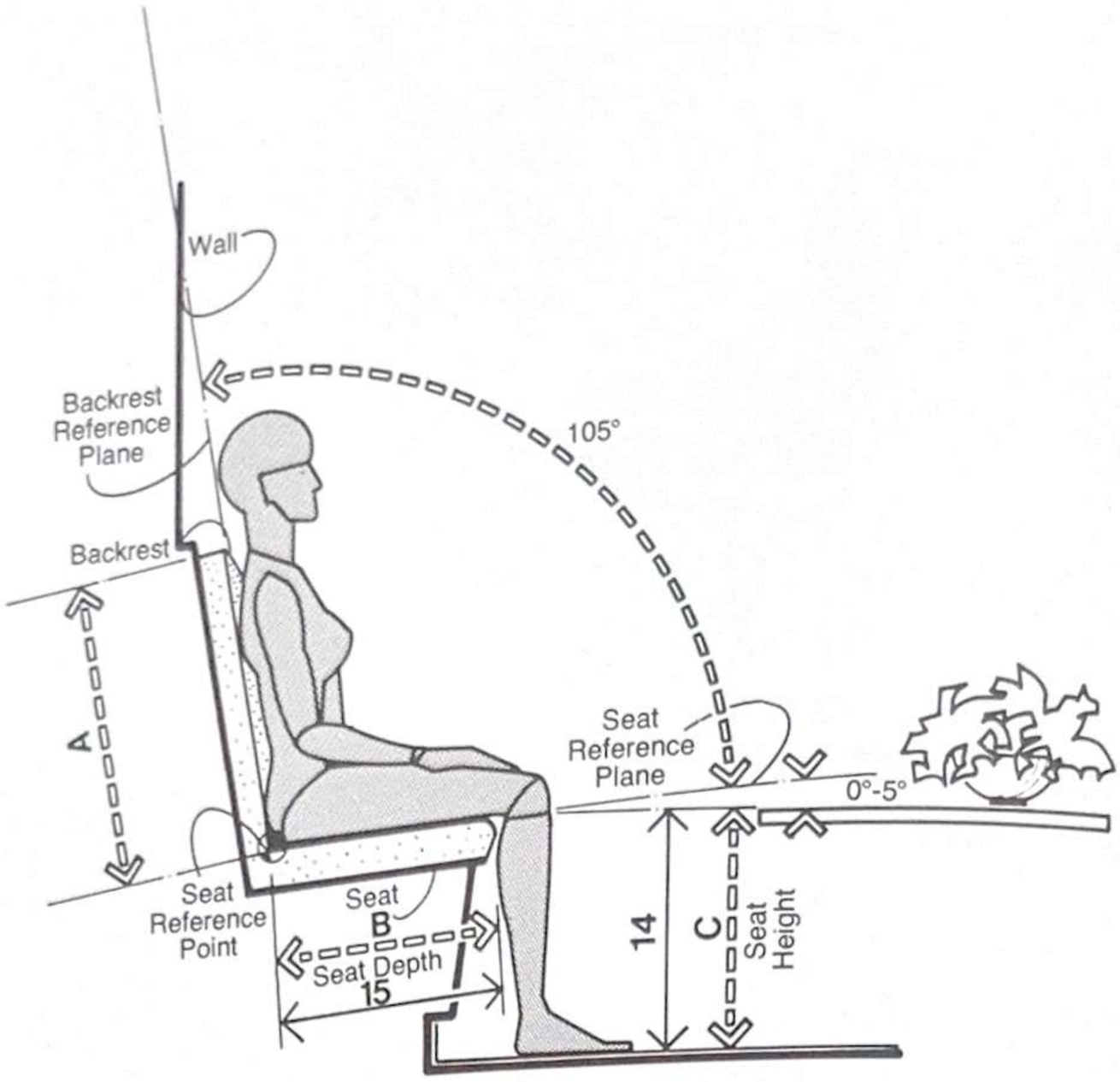
DRAFTING CHAIR / STOOL

	in	cm
A	16–17	40.6–43.2
B	8.5–9	21.6–22.9
C	10–12	25.4–30.5
D	16.5–17.5	41.9–44.5
E	18–24	45.7–61.0
F	6–9	15.2–22.9
G	10 adjust.	25.4 adjust.
H	15.5–16	39.4–40.6
I	12 max.	30.5 max.
J	30 adjust.	76.2 adjust.
K	15	38.1
L	12–14	30.5–35.6

1 SEATING

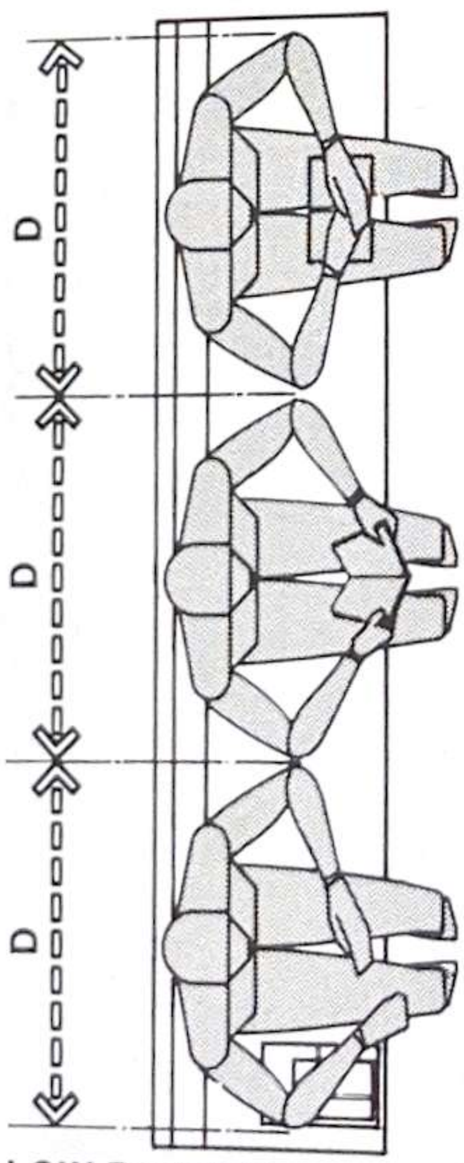
The drawings at the bottom show the basic dimensions for the design of banquette seating. The lack of armrests makes it difficult to define seat boundaries. The user, therefore, tends to establish his own territory by assuming a desired sitting posture and placing personal articles next to him, such as a briefcase, purse, or package. Since the nature of this type of seating can permit some form of body contact, hidden dimensions and personal space also play an important part in how close the users sharing the banquette will sit.

Because of the many hidden psychological factors involved, the actual efficiency of this seating type in terms of capacity is questionable. The diagrams indicate two possible seating situations, each dictated by the anthropometrics involved. One arrangement is based on the premise that the user's elbows will be extended, possibly in conjunction with some activity, such as reading, or simply as an attempt to stake out additional territory, as would be the case in the strategic positioning of some personal article on the seat. In this situation it would be reasonable to assume that each user would take up about 30 in, or 76.2 cm, of space. The other diagram shows a more compact seating arrangement. The diagram at the top shows a section through a typical banquette.

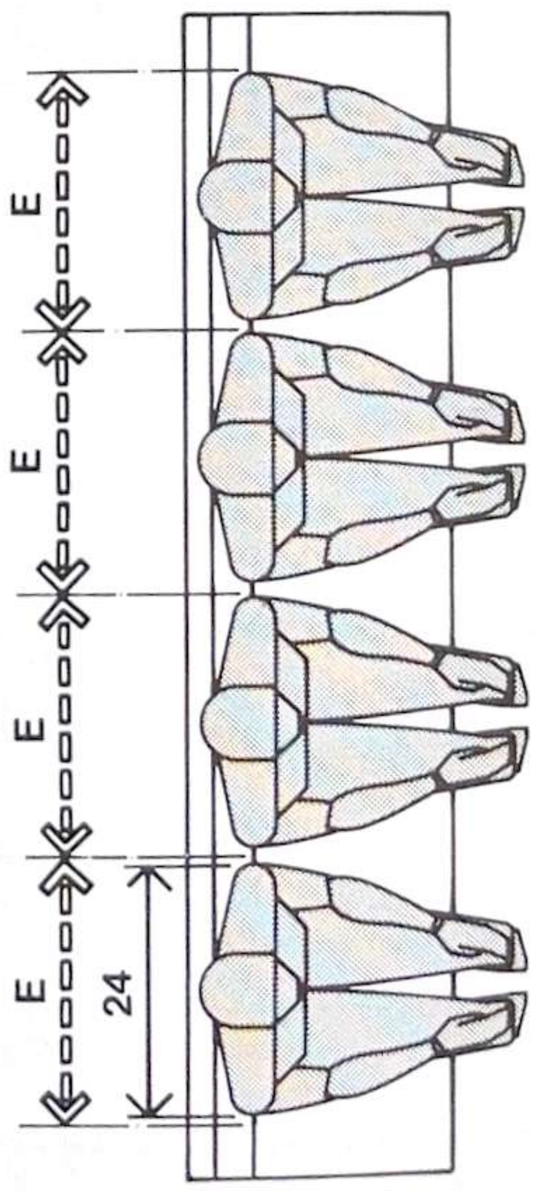


SECTION

BANQUETTE SEATING



LOW DENSITY



HIGH DENSITY

BANQUETTE SEATING

	in	cm
A	18–24	45.7–61.0
B	15.5–16	39.4–40.6
C	16–17	40.6–43.2
D	30	76.2
E	24	61.0

2 RESIDENTIAL SPACES

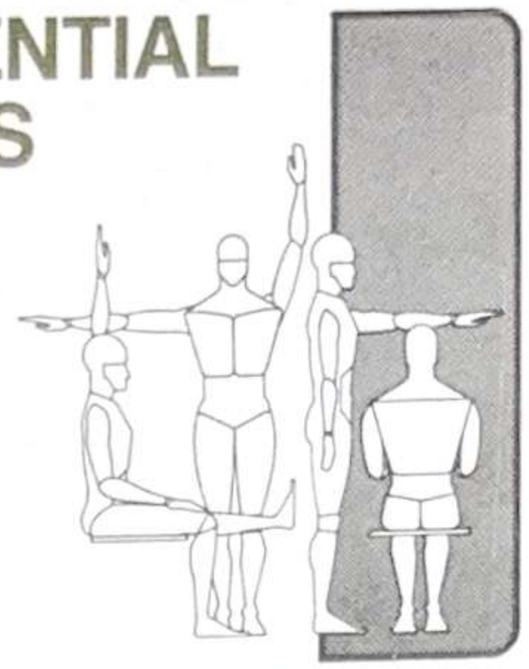


TABLE	2.1 LIVING SPACES	2.2 DINING SPACES	2.3 SLEEPING SPACES	2.4 COOKING SPACES	2.5 BATHROOMS	SPACE / ANTHROPOMETRIC DATA
1A,2B			◑	●		1 STATURE
1B,3C	◑		◑	●	◑	2 EYE HEIGHT
1C,3B				●	◑	3 ELBOW HEIGHT
1D,2C			●	●		4 SITTING HEIGHT ERECT
						5 SITTING HEIGHT NORMAL
1F,3G	◑	◑	◑	●		6 EYE HEIGHT SITTING
						7 MIDSHOULDER HEIGHT SITTING
						8 SHOULDER BREADTH
						9 ELBOW-TO-ELBOW BREADTH
1J,2F	●				●	10 HIP BREADTH
						11 ELBOW REST HEIGHT
1L,2H		●	●	●		12 THIGH CLEARANCE
1M,2I		●	●			13 KNEE HEIGHT
1N,2J		◑	◑			14 POPLITEAL HEIGHT
1O,2K	◑					15 BUTTOCK-POPLITEAL LENGTH
1P,2L		●	●	●	●	16 BUTTOCK-KNEE LENGTH
1Q,3F	◑					17 BUTTOCK-TOE LENGTH
1R,4B	◑				◑	18 BUTTOCK-HEEL LENGTH
1S,4C					○	19 VERTICAL REACH HEIGHT SITTING
1T,4F				○	○	20 VERTICAL GRIP REACH
1U,4E					○	21 SIDE ARM REACH
1V,4D		○		○	○	22 THUMB TIP REACH
1W,6B	●	●	●	●	●	23 MAXIMUM BODY DEPTH
1X,6A	●	●	●	●	◑	24 MAXIMUM BODY BREADTH

The variety of human activity that occurs within residential spaces, whether they be studio apartments, two- and three-bedroom cooperatives, or suburban houses, is formidable. It is within this single environment that people sleep, dine, relax, meditate, entertain and are entertained, make love, do housework, read, cook, bathe, are conceived, and in some cases are born or die. It is also within these spaces that people spend at least half of their waking hours and are subjected to most of the physical injuries they are likely to sustain during the course of their lifetime. The impressive number and diversity of functions that must take place within this single environment, the extended period of time that people spend within it, and their vulnerability to fatigue and accidents give the quality of their interface with that environment added significance. Another factor that makes the quality of interface even more critical is the decrease in the size of residential spaces available on today's market due to the increasing costs of both construction and land. As a consequence of these external economic factors, it becomes necessary in many cases to maximize the utilization of existing space to the greatest degree possible. In some instances this involves innovative ways of perceiving both the problem and the design solution. For example, it may be necessary to explore the use of overhead space, to have a single portion of the space perform several functions, or to creatively recycle space, formerly used for a different purpose, to accommodate a residential function. The text and illustrations to follow deal with human dimension and residential space in terms of the major functions that must be accommodated.

2.1 LIVING SPACES

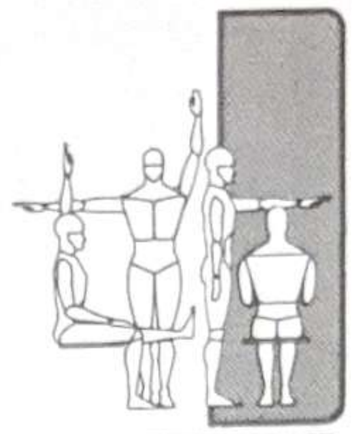


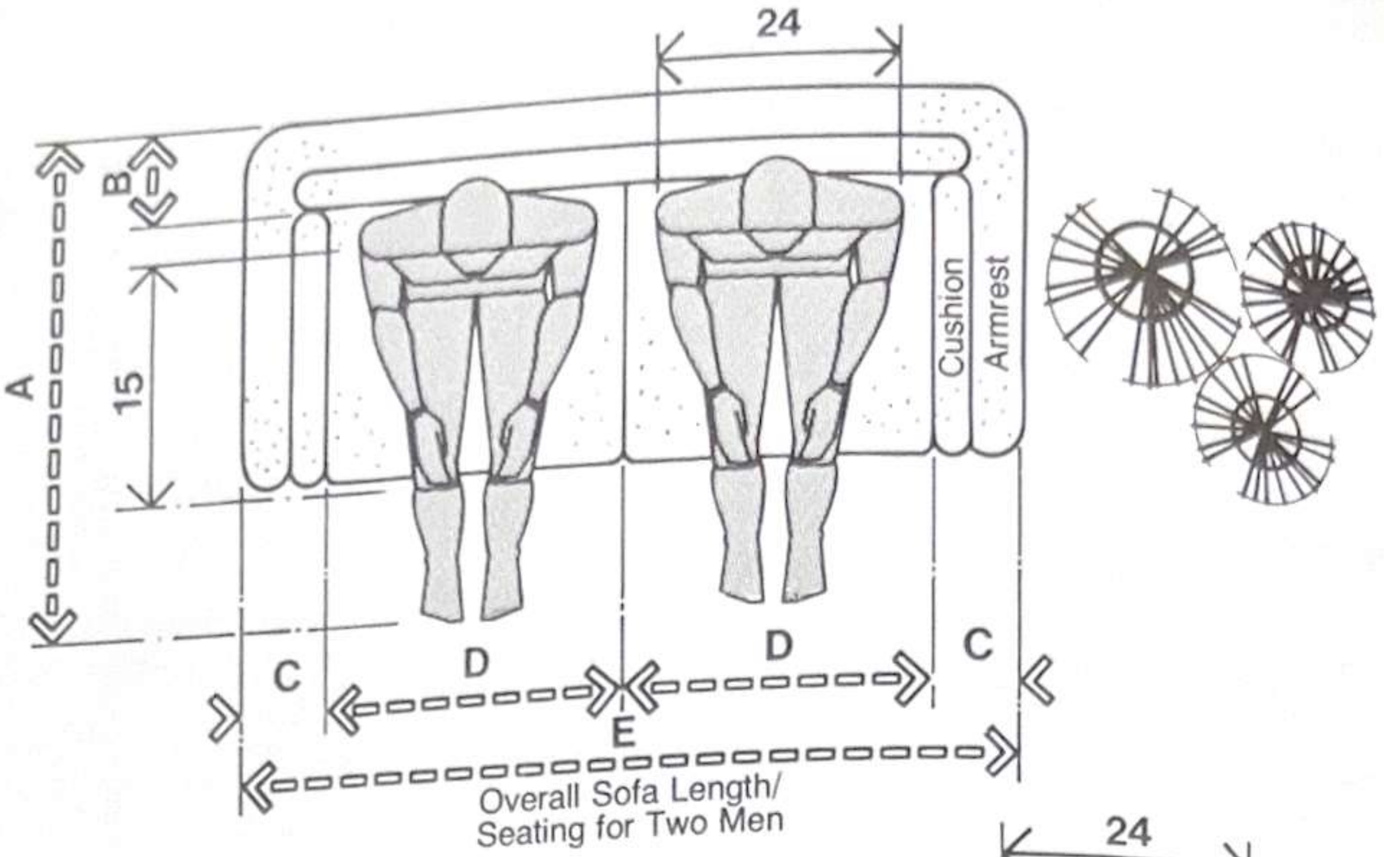
TABLE	LOUNGING	CIRCULATION	BAR/STORAGE	ACTIVITIES	ANTHROPOMETRIC DATA
1B,3C			◑	2	EYE HEIGHT
1F,3G	◑			6	EYE HEIGHT SITTING
1J,2F	●			10	HIP BREADTH
1O,2K	◑			15	BUTTOCK-POPLITEAL LENGTH
1Q,3F	◑			17	BUTTOCK-TOE LENGTH
1R,4B	◑			18	BUTTOCK-HEEL LENGTH
1W,6B			●	23	MAXIMUM BODY DEPTH
1X,6A	●	●		24	MAXIMUM BODY BREADTH

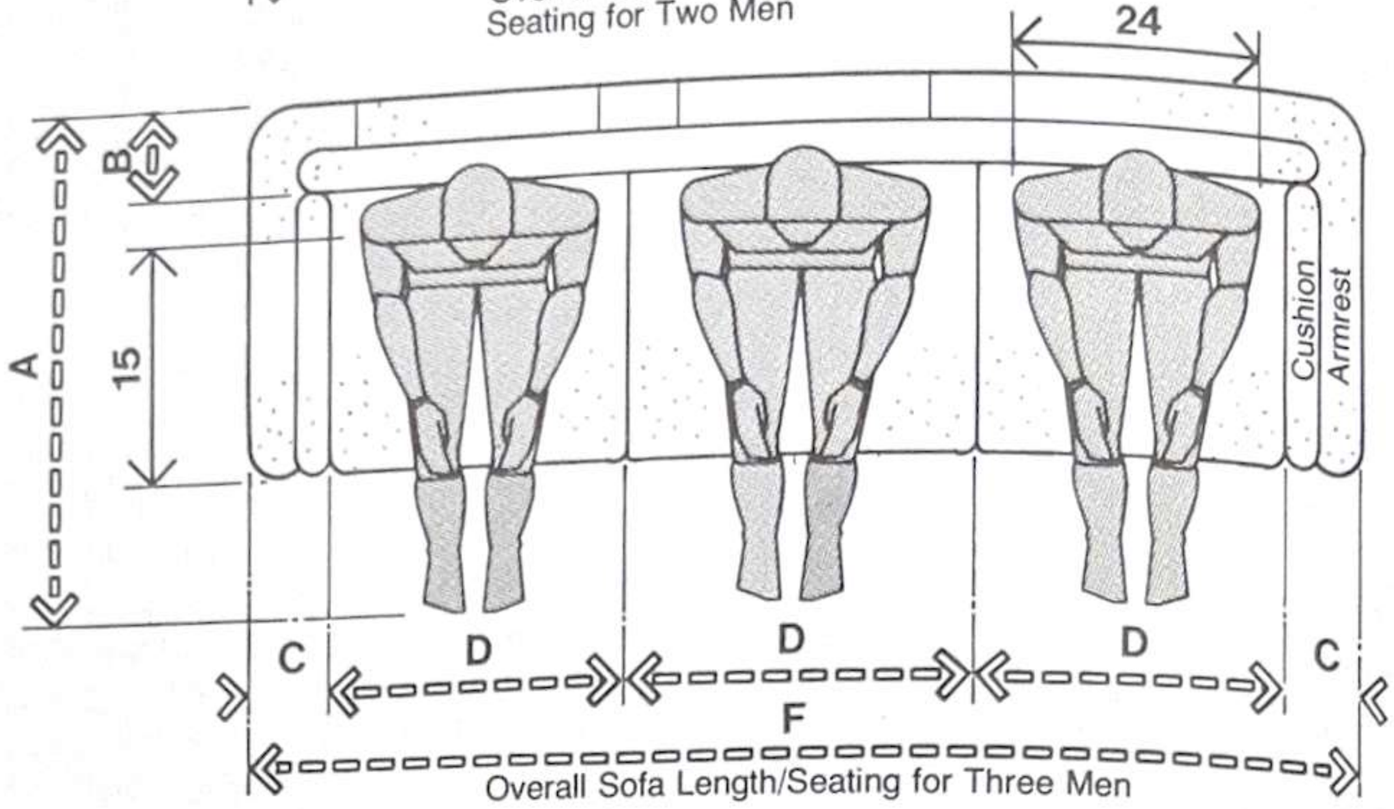
The various activities and elements of furniture usually associated with living spaces result in many levels of interface between the human body and the physical components of the space. The most obvious is between the user and the chair or sofa. In this regard seat height must take into consideration popliteal height, while seat depth must be responsive to buttock-popliteal length. Circulation around seating elements must accommodate maximum body breadth, while the location of a coffee table in relation to a chair should be responsive to human reach dimensions. The height at which a painting is hung on a wall should be determined in relationship to eye height. The possibilities are almost endless and the drawings on the following pages explore only a few of the many design situations that require knowledge of human dimensions. The matrix above indicates some of the anthropometric measurements to take into consideration to ensure the proper levels of interface.

2.1 LIVING SPACES

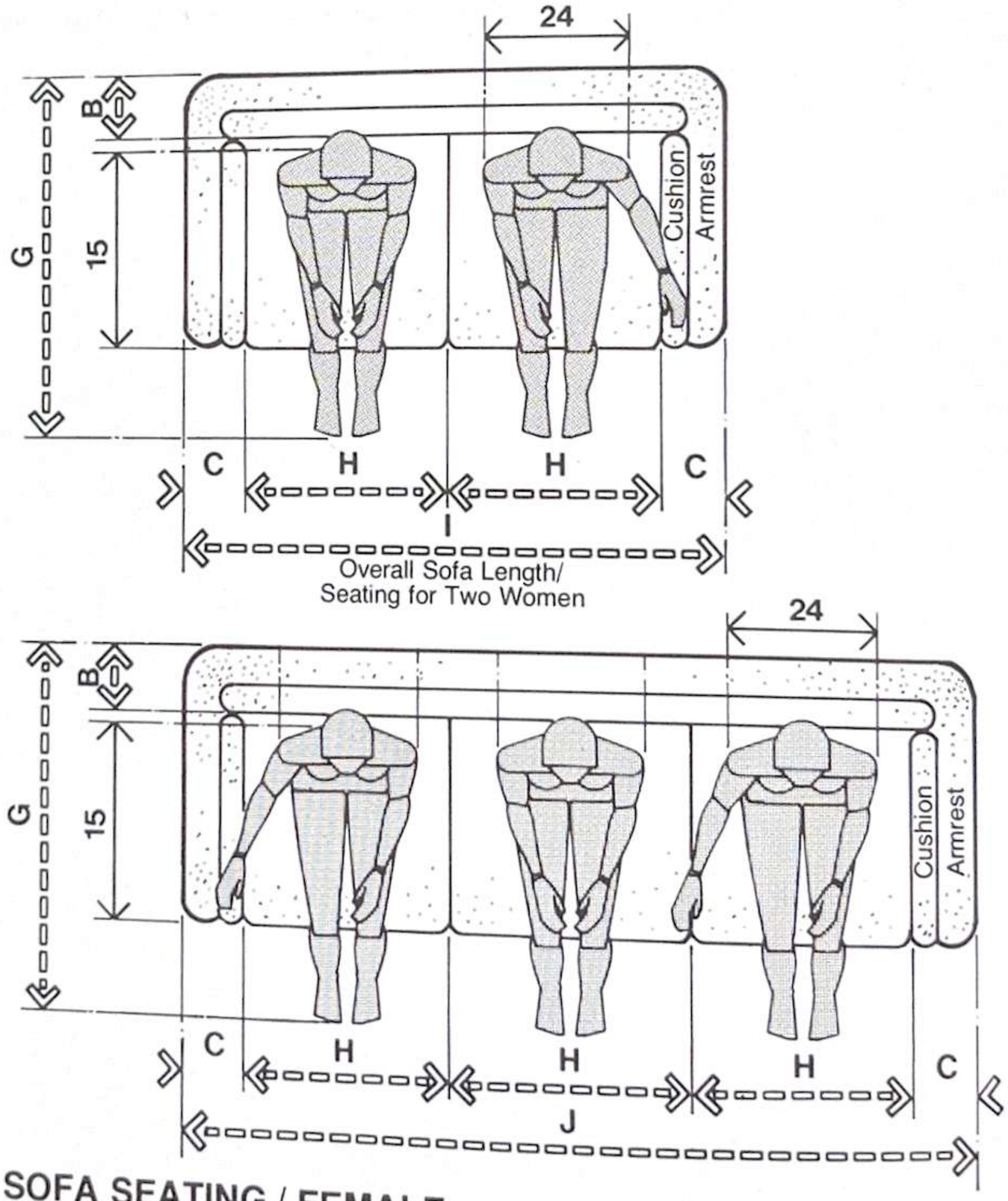
The drawings here examine the relationship of female and male body dimensions to sofa seating, in order to determine how much space the seated body requires. The anthropometric measurements of major interest here are maximum body breadth and buttock-popliteal length.

The top drawing deals with male dimensions; based on 95th percentile data, the maximum body breadth dimension is 22.8 in, or 57.9 cm, with a nude subject. Allowing for clothing and some body movement as well as change in posture and position, a minimum dimension of 28 in, or 71.1 cm, is suggested as a width allowance for a seated person. The overall dimension, therefore, includes the individual width allowances and the width of a sofa arm construction, which obviously can vary depending on personal design preference. A range of 3 to 6 in, or 7.6 to 15.2 cm, is suggested. Using the buttock-popliteal length of the smaller person and adding a similar allowance of 6 to 9 in, or 15.2 to 22.9 cm, for backrest construction as well as a minimum zone in front of the sofa for foot movement, an overall depth dimension of 42 to 48 in, or 106.7 to 121.9 cm, is suggested. The rationale for the drawing at the bottom dealing with female data is the same. The information should prove not only useful in providing a keener insight into the general relationship between body size and furniture but of specific value in establishing preliminary design assumptions for institutional seating in spaces designed exclusively for the use of males or of females. In spaces where seating is to be used by both sexes, the larger dimensions should apply.





SOFA SEATING / MALES



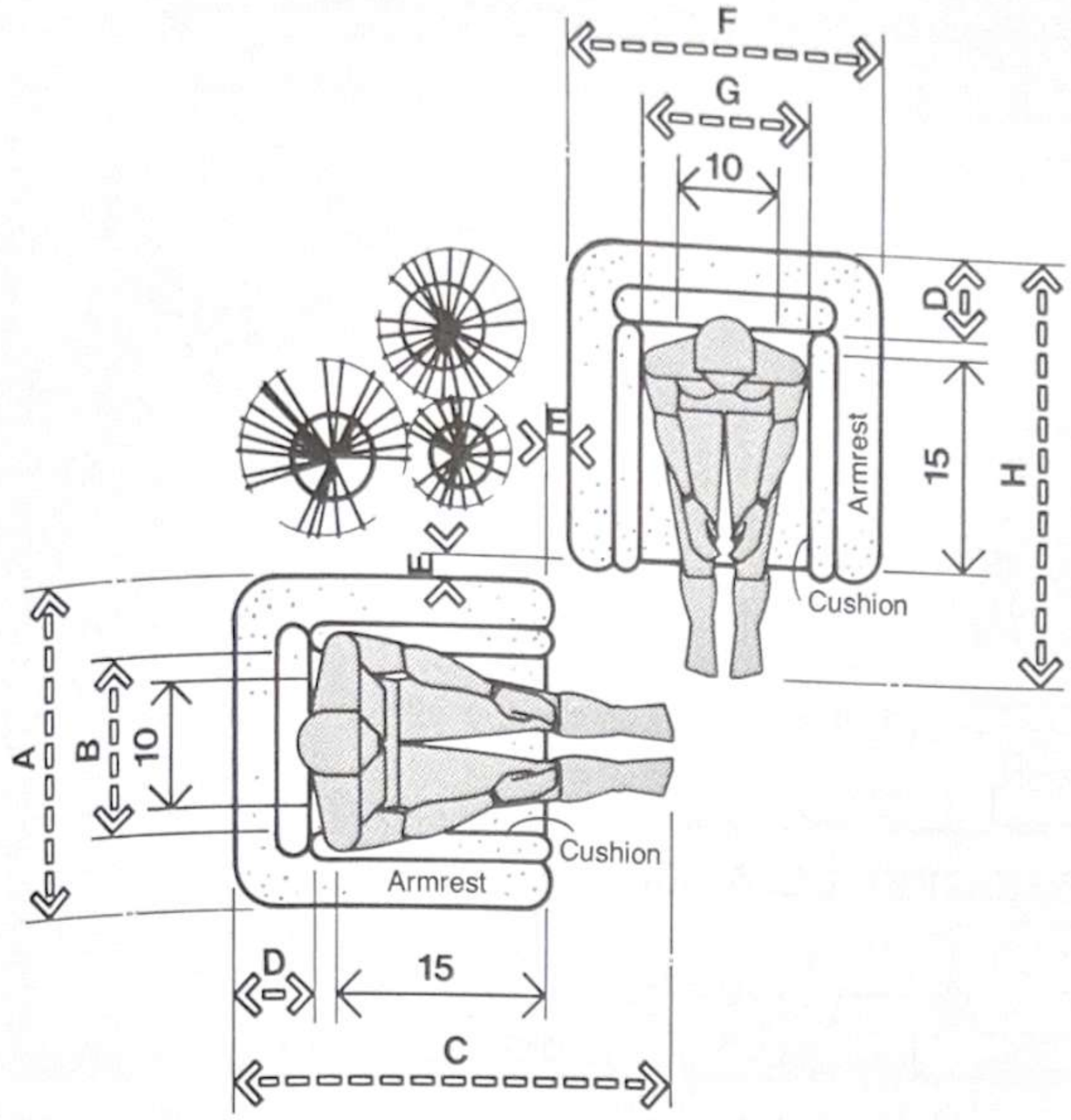
SOFA SEATING / FEMALE

	in	cm
A	42–48	106.7–121.9
B	6–9	15.2–22.9
C	3–6	7.6–15.2
D	28	71.1
E	62–68	157.5–172.7
F	90–96	228.6–243.8
G	40–46	101.6–116.8
H	26	66.0
I	58–64	147.3–162.6
J	84–90	213.4–228.6

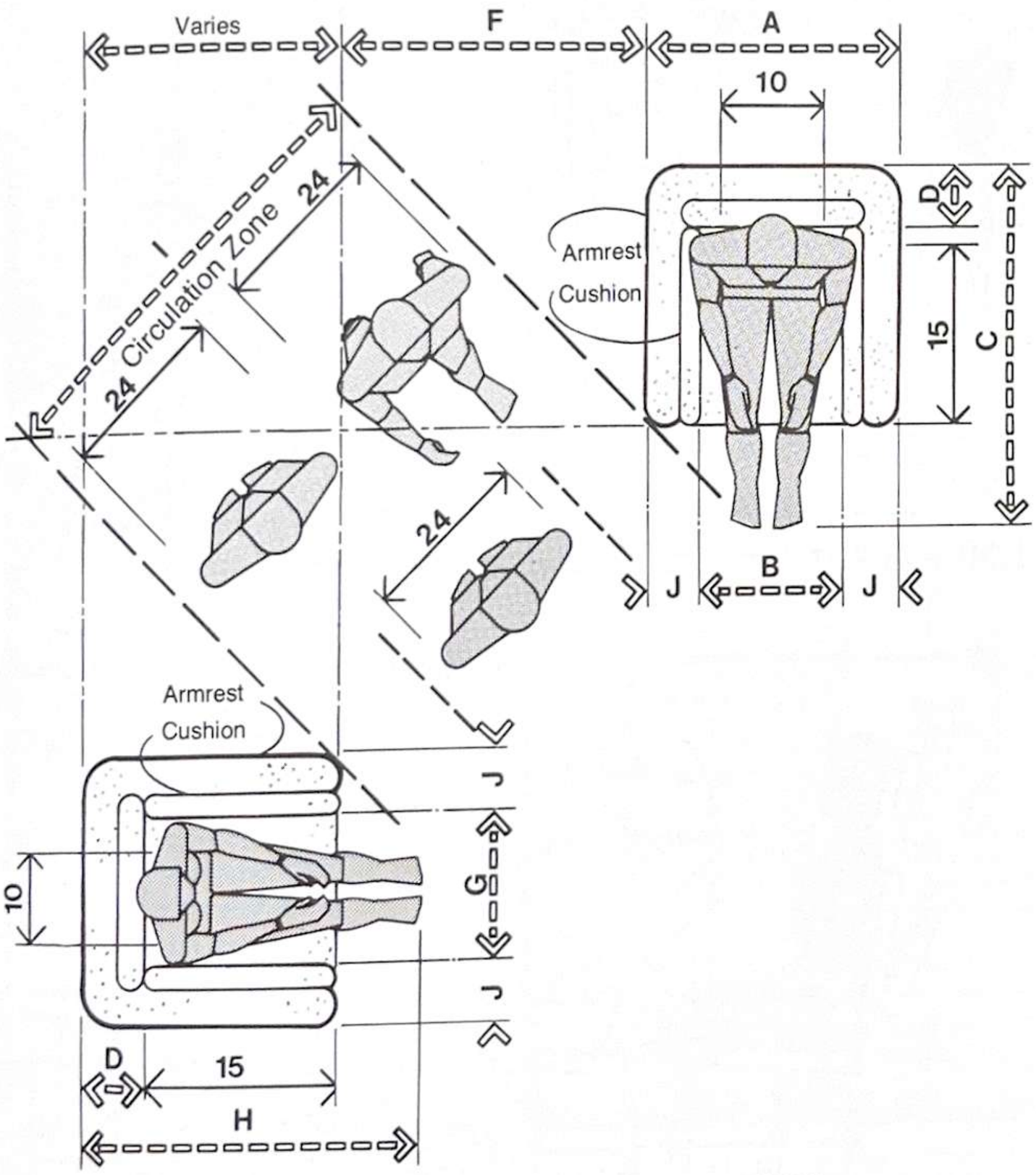
2.1 LIVING SPACES

The top drawing examines the relationship of the female and male body dimensions to arm chair seating in order to determine the amount of space the seated body requires. The rationale is similar to that in dealing with sofa seating, outlined on the preceding page.

The bottom drawing is not intended to suggest a specific layout for a conversational grouping, and therefore should not be taken literally. Nor is it suggested that special female and male seating be provided in the same living space. The drawing is essentially informative and its purpose is to suggest allowances for comfortable circulation relative to corner lounge seating situations. The key consideration anthropometrically is maximum body breadth data. Since clearance is involved, the data related to the larger person rather than the smaller should be used.



CORNER LOUNGE CHAIR SEATING/ MALE AND FEMALE



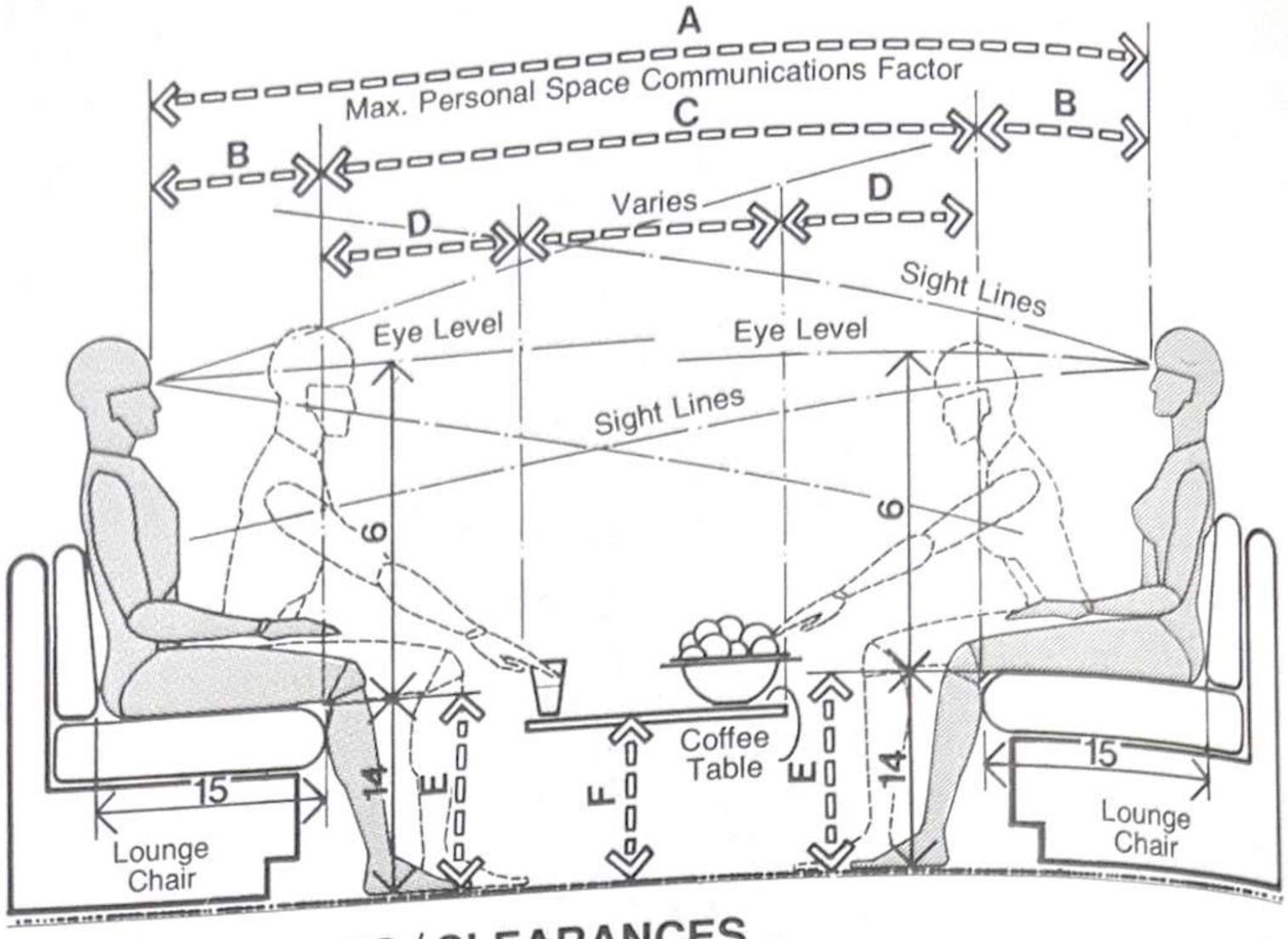
CORNER LOUNGE SEATING WITH CIRCULATION

	in	cm
A	34–40	86.4–101.6
B	28	71.1
C	42–48	106.7–121.9
D	6–9	15.2–22.9
E	3	7.6
F	32–38	81.3–96.5
G	26	66.0
H	40–46	101.6–116.8
I	48–60	121.9–152.4
J	3–6	7.6–15.2

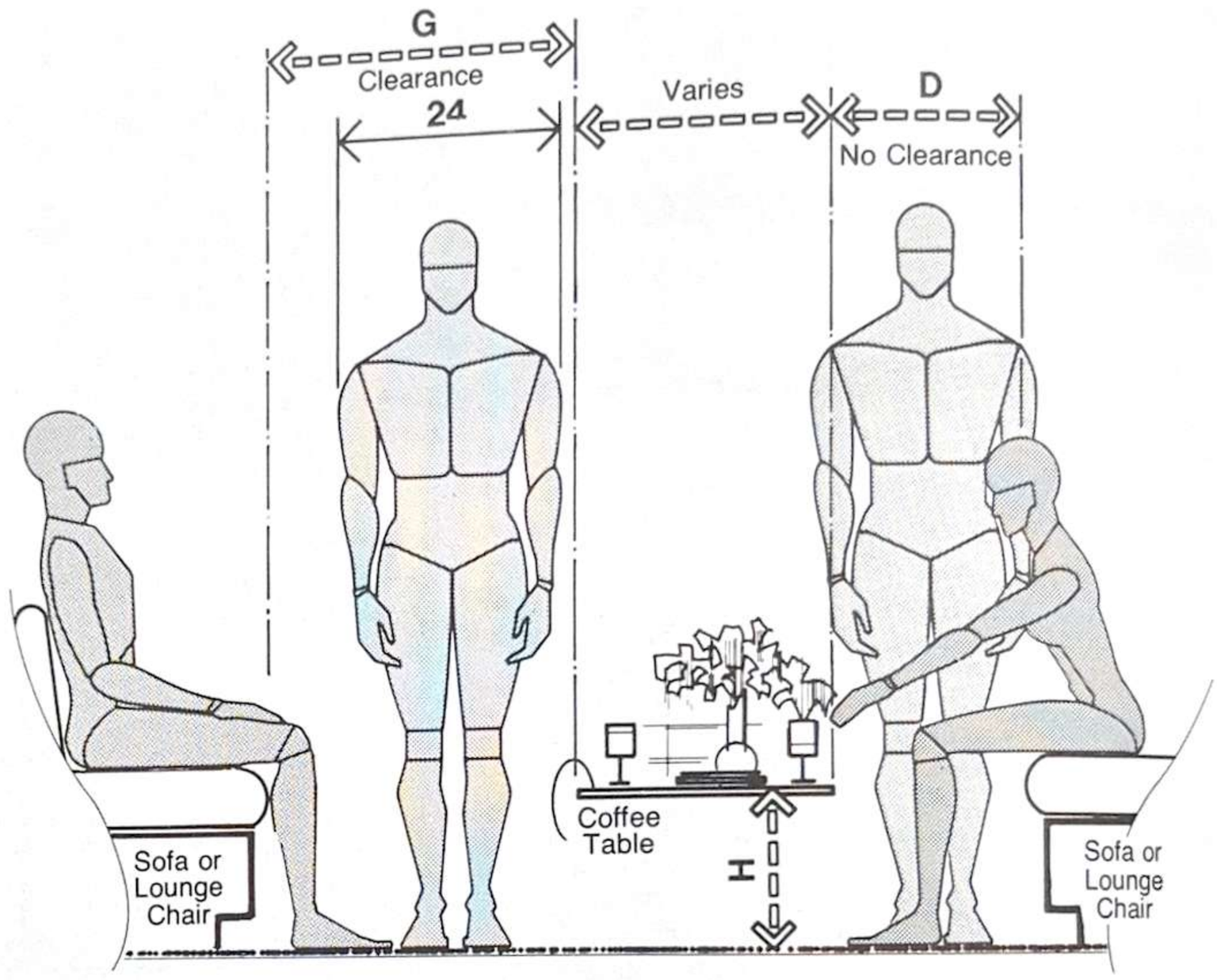
2.1 LIVING SPACES

The drawings at the top and center deal with the major clearances involved in lounge or conversational seating. The top drawing is based on a conversational grouping in which the clearance between the front of the seat and the edge of the table is limited between 16 and 18 in, or 40.6 and 45.7 cm. This clearance may require some degree of body contact or sidestepping for circulation and access. Anthropometrically, however, it does accommodate human reach, permitting the seated person access to the coffee table without rising. The drawing also suggests a dimensional range for verbal conversation. The center drawing illustrates a similar furniture arrangement that would permit circulation with full head-on access. The clearance indicated, however, to permit such access would make it impossible for most people to reach the coffee table from a seated position. This could be extremely undesirable in terms of food, beverages, and cigarettes. Given the choice between full head-on access and the accommodation of reach, the authors opt for reach and recommend the smaller clearance.

The bottom drawing suggests an overall allowance for easy chair or reclining chair seating, including footrest. The buttock-leg length of the larger person is the most significant anthropometric measurement in establishing this clearance. It should also be noted that the height of the footrest is also a function of seat height. The footrest should be a few inches below the height of the seat.

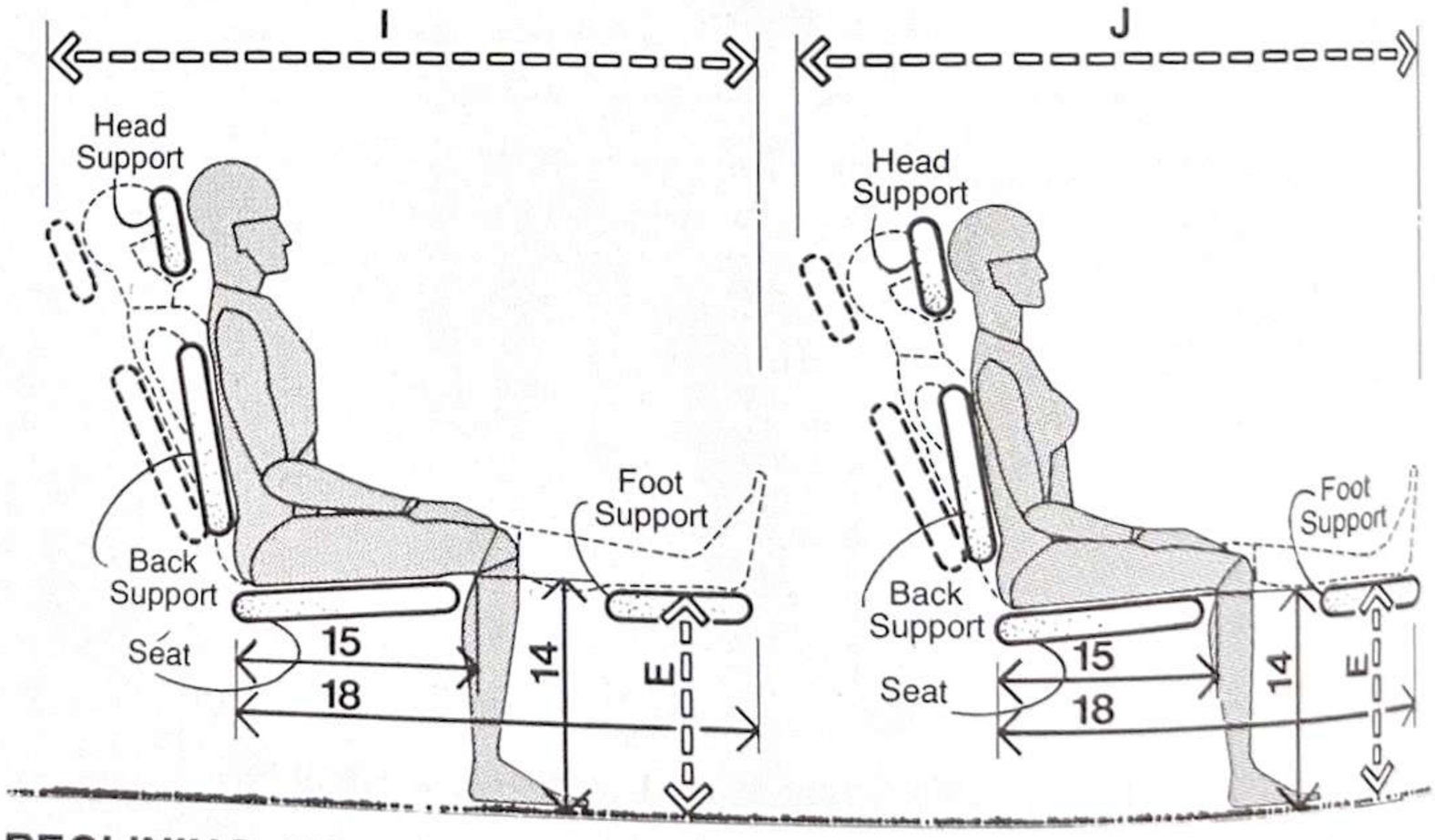


LOUNGE SEATING / CLEARANCES



LOUNGE SEATING / CLEARANCE RELATIONSHIPS

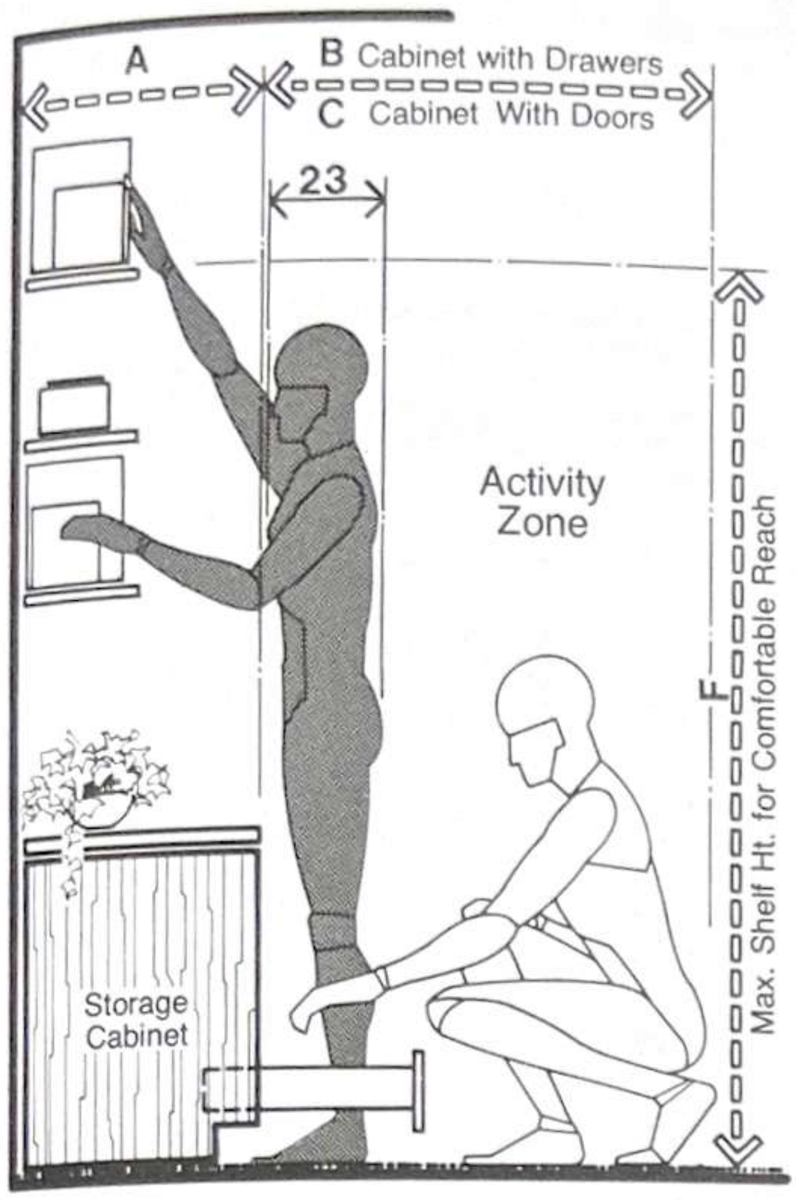
	in	cm
A	84–112	213.4–284.5
B	13–16	33.0–40.6
C	58–80	147.3–203.2
D	16–18	40.6–45.7
E	14–17	35.6–43.2
F	12–18	30.5–45.7
G	30–36	76.2–91.4
H	12–16	30.5–40.6
I	60–68	152.4–172.7
J	54–62	137.2–157.5



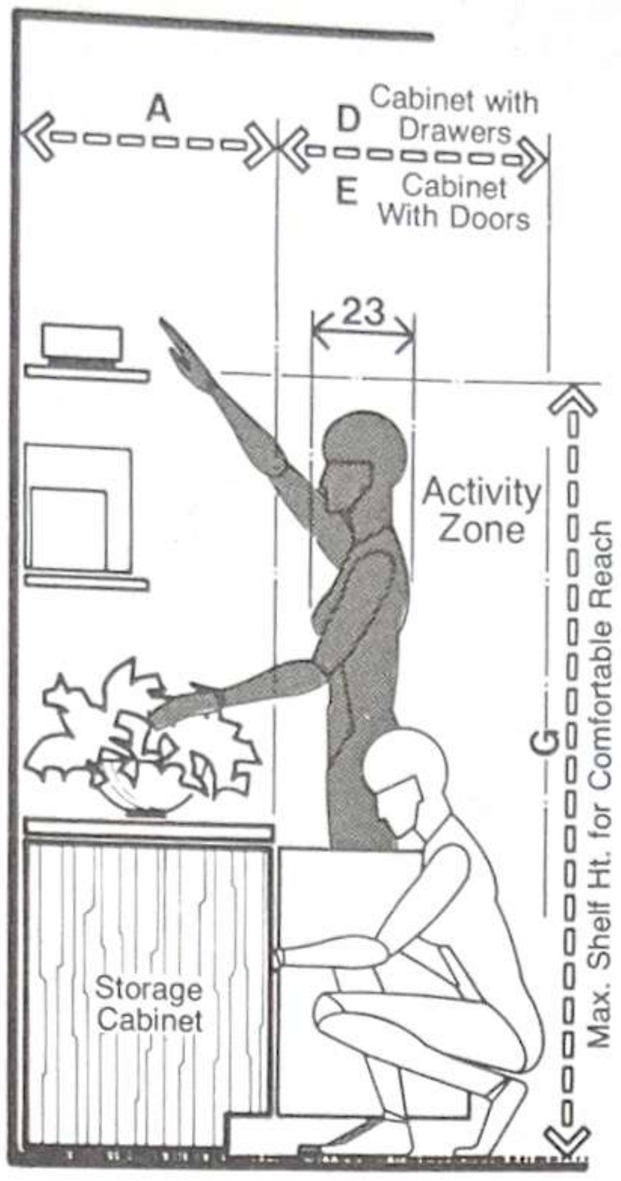
RECLINING CHAIR WITH FOOTREST / MALE AND FEMALE

2.1 LIVING SPACES

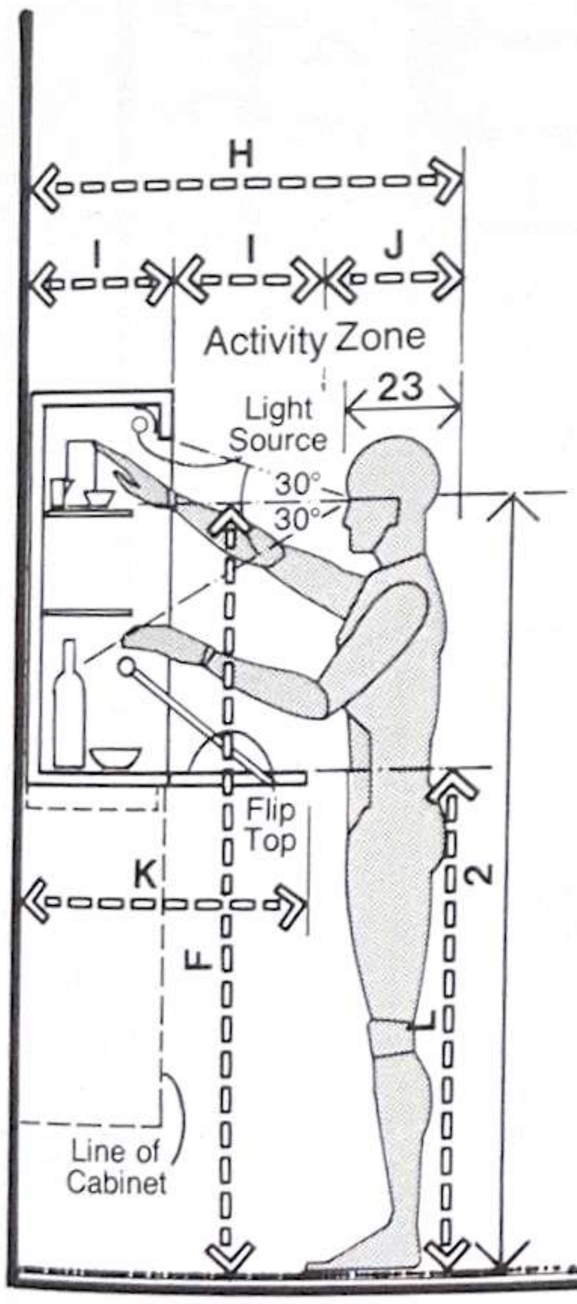
The drawings on this page illustrate the relationship of human dimension and accessibility to low and high storage or furniture usually associated with living spaces. The configuration of the furniture is not intended as a realistic illustration of any specific element of furniture, but rather as a general representation of furniture types normally found in a living space. In situations where the user is not a known entity, either in terms of sex or body size, the body size data of the smaller person should govern. In the event the user is known, dimensions more appropriate to that body size should be used where practical. It should be noted that for each sex two dimensions are shown on the drawing. In each case the lower figure is based on 5th percentile body size data and the larger on 95th percentile data.



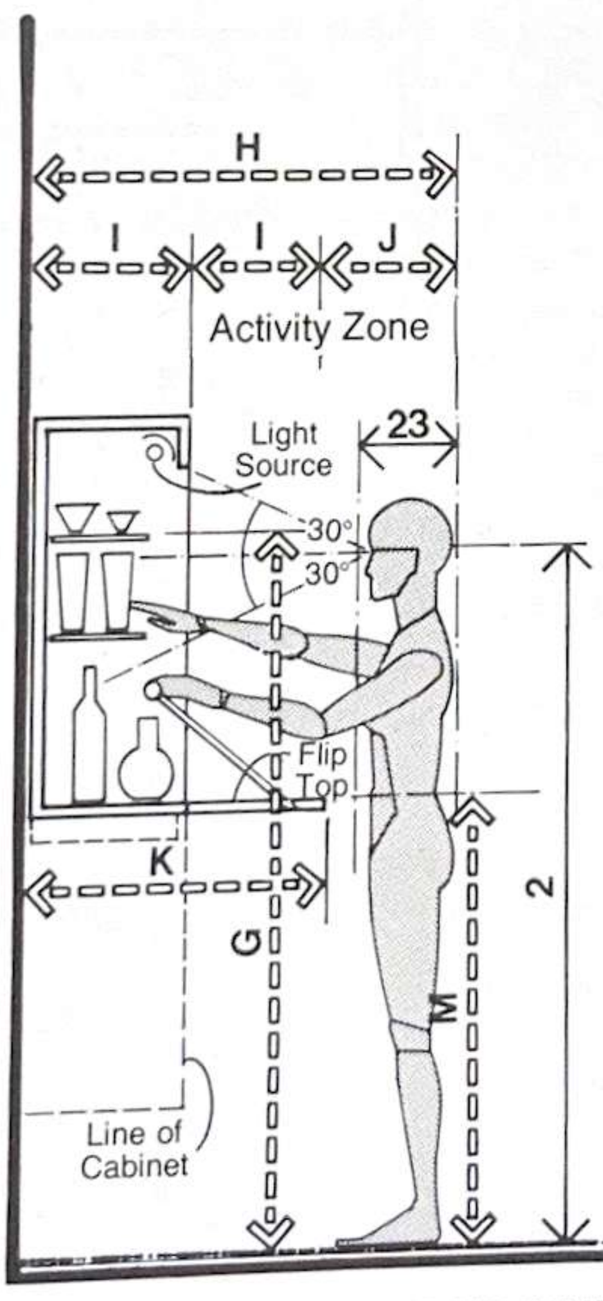
WALL UNIT / ACCESS BY MALE



WALL UNIT/ ACCESS BY FEMALE



WALL-MOUNTED BAR UNIT/ ACCESS BY MALE

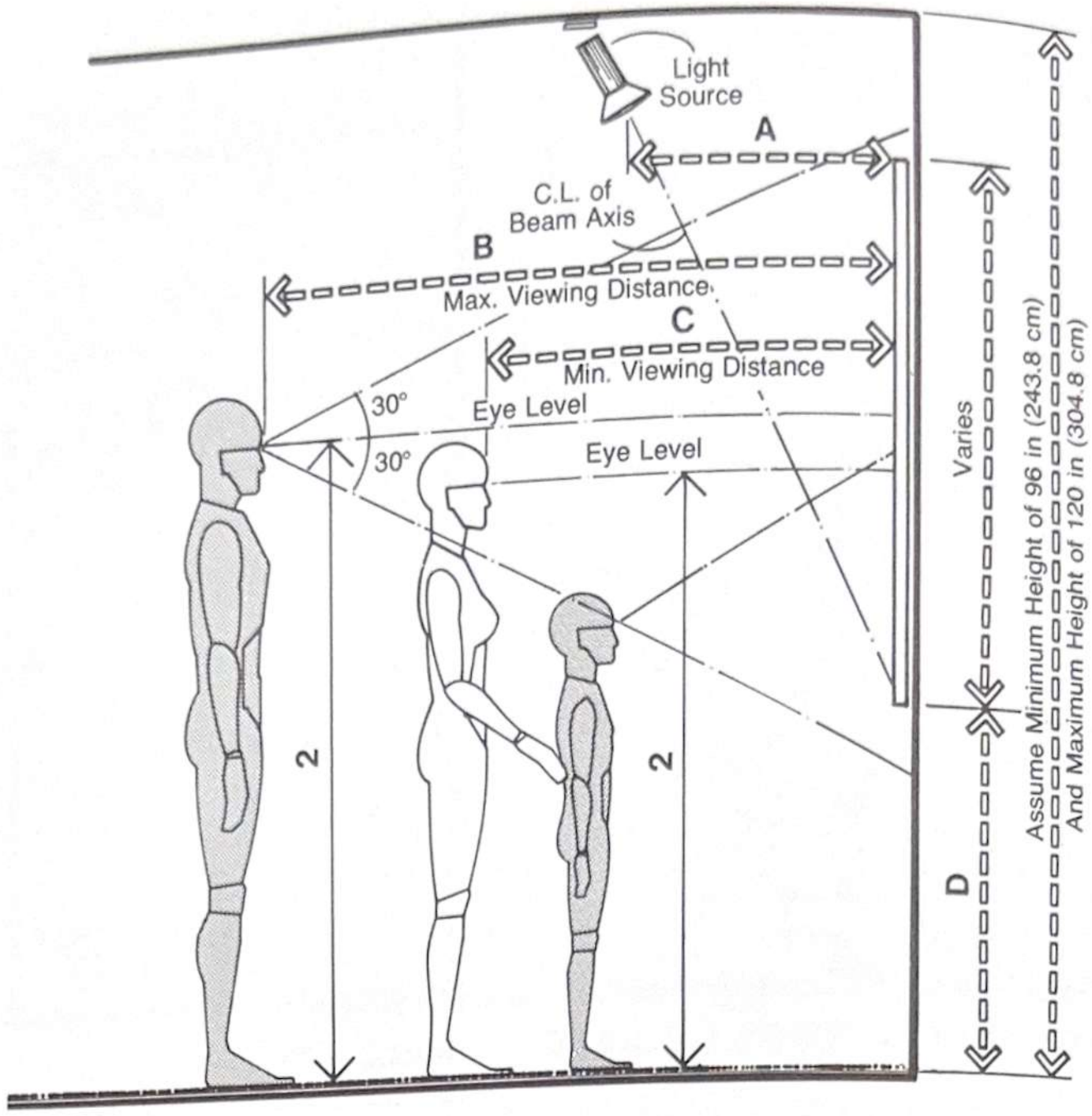


WALL-MOUNTED BAR UNIT/ ACCESS BY FEMALE

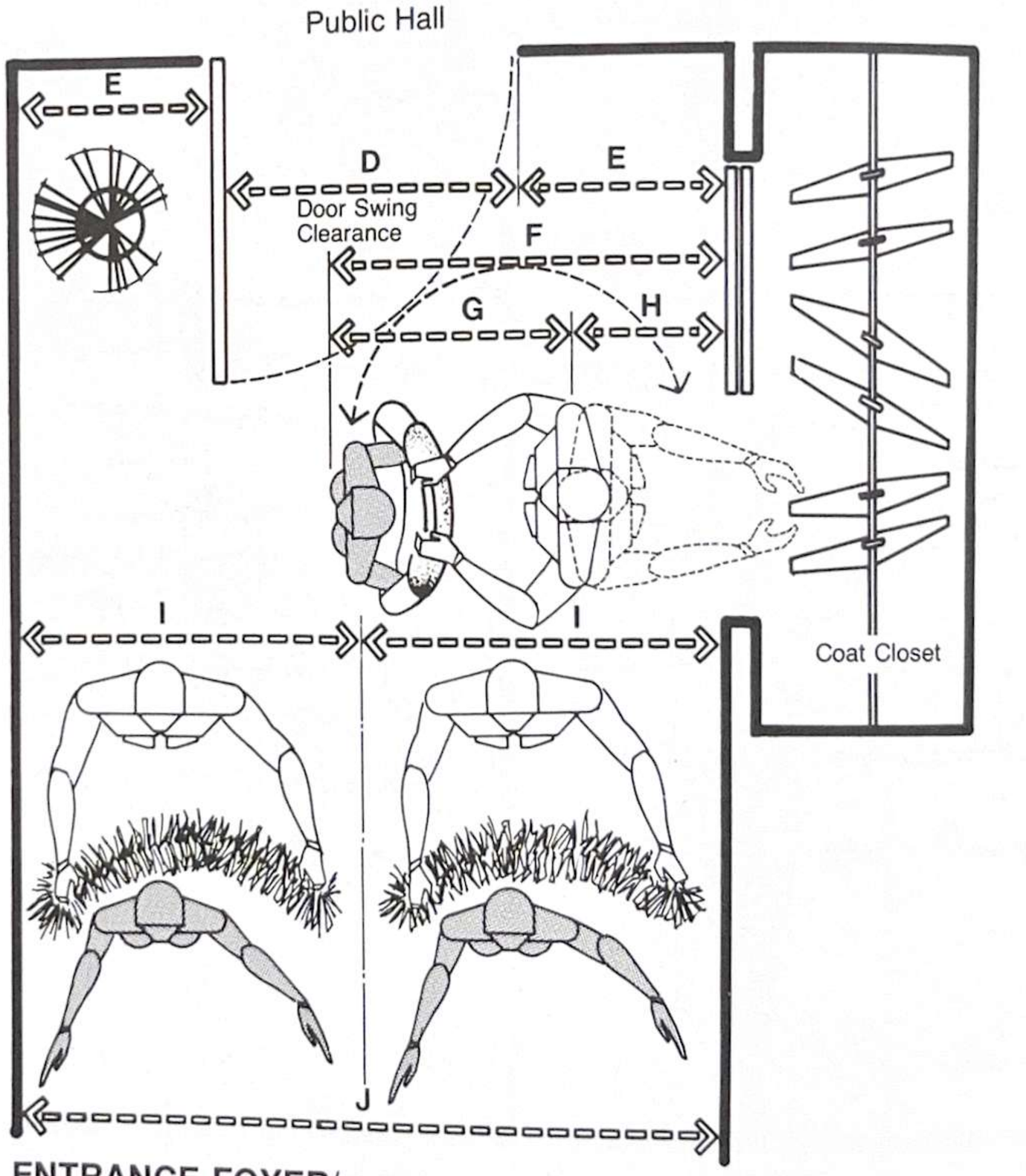
	in	cm
A	18–24	45.7–61.0
B	48–58	121.9–147.3
C	36–40	91.4–101.6
D	46–52	116.8–132.08
E	30–36	76.2–91.4
F	72	182.9
G	69	175.3
H	42–50	106.7–127.0
I	12–16	30.5–40.6
J	18	45.7
K	24–32	61.0–81.3
L	39–42	99.1–106.7
M	36–39	91.4–99.1

2.1 LIVING SPACES

The top drawing illustrates the relationship between human dimension and the display of art work. Eye height is the significant anthropometric body measurement here. It should be noted, however, that the visual angle in which small detail can be sharply defined without rotating the eyes is only about 1°. Therefore, the drawing should be used as a basis for preliminary design assumptions about art work generally, and even in viewing the art work shown here, a certain amount of scanning or eye rotation is required. In addition, the horizontality of the line of sight is theoretical. Most of the time the body and head are in a relaxed position and the line of sight is slightly below the horizontal. A more detailed discussion of the visual and anthropometric considerations regarding the viewing of displays can be found in Section 9 in Part C. The bottom drawing provides some useful information concerning human dimension and the clearances required for coat removal.



DISPLAY OF ARTWORK



	in	cm
A	16–24	40.6–61.0
B	60–78	152.4–198.1
C	30–42	76.2–106.7
D	36	91.4
E	20–24	50.8–61.0
F	51	129.5
G	33	83.8
H	18	45.7
I	40–44	101.6–111.8
J	80–88	203.2–223.5

ENTRANCE FOYER/ REQUIRED CLEARANCES FOR COAT REMOVAL

2.2 DINING SPACES

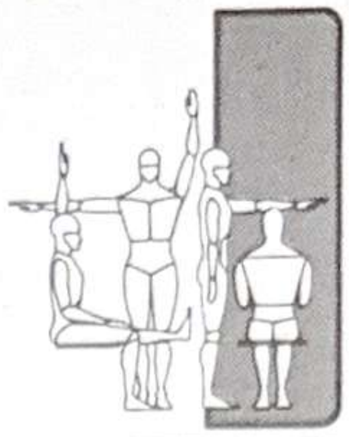


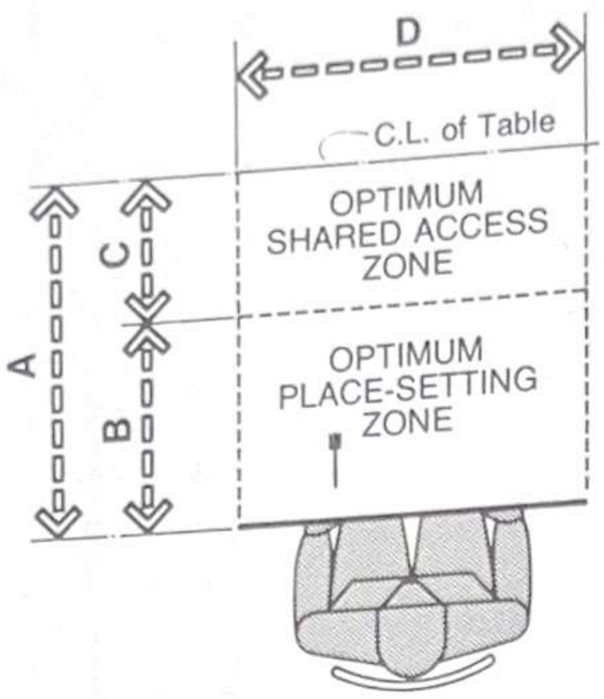
TABLE	DINING	CIRCULATION	SERVICE	ACTIVITIES	ANTHROPOMETRIC DATA
1F,3G	◐			6	EYE HEIGHT SITTING
1L,2H	●			12	THIGH CLEARANCE
1M,2I	●			13	KNEE HEIGHT
1N,2J	◐			14	POPLITEAL HEIGHT
1P,2L	●			16	BUTTOCK-KNEE LENGTH
1V,4D	○			22	THUMB TIP REACH
1W,6B	●		●	23	MAXIMUM BODY DEPTH
1X,6A	●	●	●	24	MAXIMUM BODY BREADTH

In examining the relationship between human dimension and dining spaces, the areas of most concern to the designer are the clearances around the table and the number of people a table of a particular size can accommodate. The clearance between the edge of the table and the wall or any other physical obstruction must at the very least accommodate two elements: (1) the space occupied by the chair and (2) the maximum body breadth of a person of larger body size as he circulates between the chair and the wall. In dealing with the space occupied by the chair, it should be noted that its position, relative to the edge of the table, will change several times during the course of a meal. Towards the end of a meal, perhaps while the person is engaged in informal conversation or in an effort to change body posture, the chair may be extended farther from the table. As a person leaves the table, the chair may be located even farther away. Comfortable clearance should assume the chair to be at its farthest distance from the table.

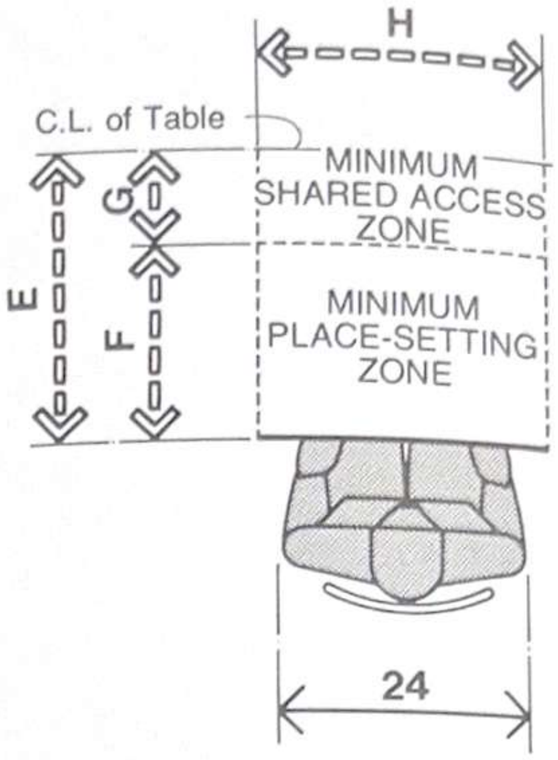
Too often in calculating the number of people to be accommodated around the table, the designer relies exclusively on plastic furniture templates or on the application of a 24-in, or 61-cm, center to center chair spacing, instead of considering the maximum body breadth of the person of larger body size, the fact that the elbows may be extended, and, finally, the size of the place setting itself. To ensure a proper interface between the human body and the table during the dining process, not only must the anthropometric considerations discussed above be taken into account, but the human body, the chair, the table, and the place setting must be viewed as a system. It should also be noted that the size of the place setting will determine how much table area will be available for centrally located shared elements, such as beverages or serving dishes. The drawings on the following pages examine all these conditions and should be helpful not only in making preliminary design assumptions, but more importantly in establishing an approach for individual design analysis.

2.2 DINING SPACES

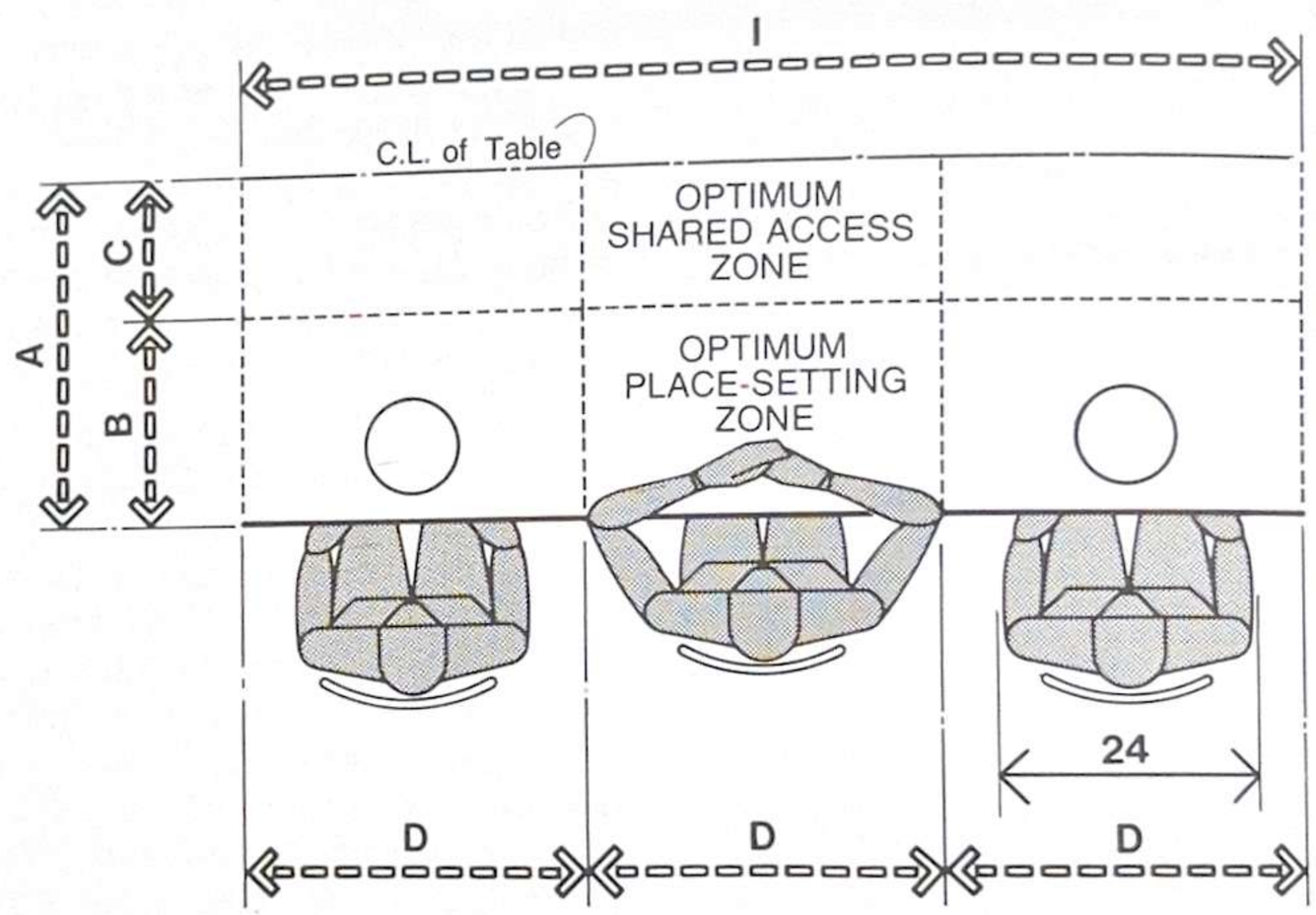
To determine table size it is helpful to view the table as consisting of two zones. The place setting zone represents the personal activity space directly in front of the individual diner. Ideally, it should be of adequate size to accommodate the necessary dinnerware, silverware, glassware, etc., both in its original structured form and in its eventual state of disarray during the course of its use. The width of this zone should also accommodate the human dimension and body positions assumed during the eating process. Etiquette aside, it should be generous enough to allow for the inevitable projection of the elbows. Anthropometrically, the maximum body breadth measurement of the larger person should be considered. Accordingly, the optimal width suggested for this zone, allowing for elbow projection, is about 30 in, or 76.2 cm, and the minimal width about 24 in, or 61 cm. To allow for the elements of the setting itself, the optimal and minimal depths suggested for this zone are 18 and 16 in, or 45.7 and 40.6 cm, respectively. The optimal place setting zone can be viewed as a rectangle, 30 by 18 in, or 76.2 by 45.7 cm, and the minimal zone, 24 by 16 in, or 61 by 40.6 cm. The shared access zone represents the table space opposite the place setting zones necessary to accommodate serving dishes and platter, related silverware, glasses, decorative centerpieces, candelabras, etc. The size of this zone varies greatly and is a



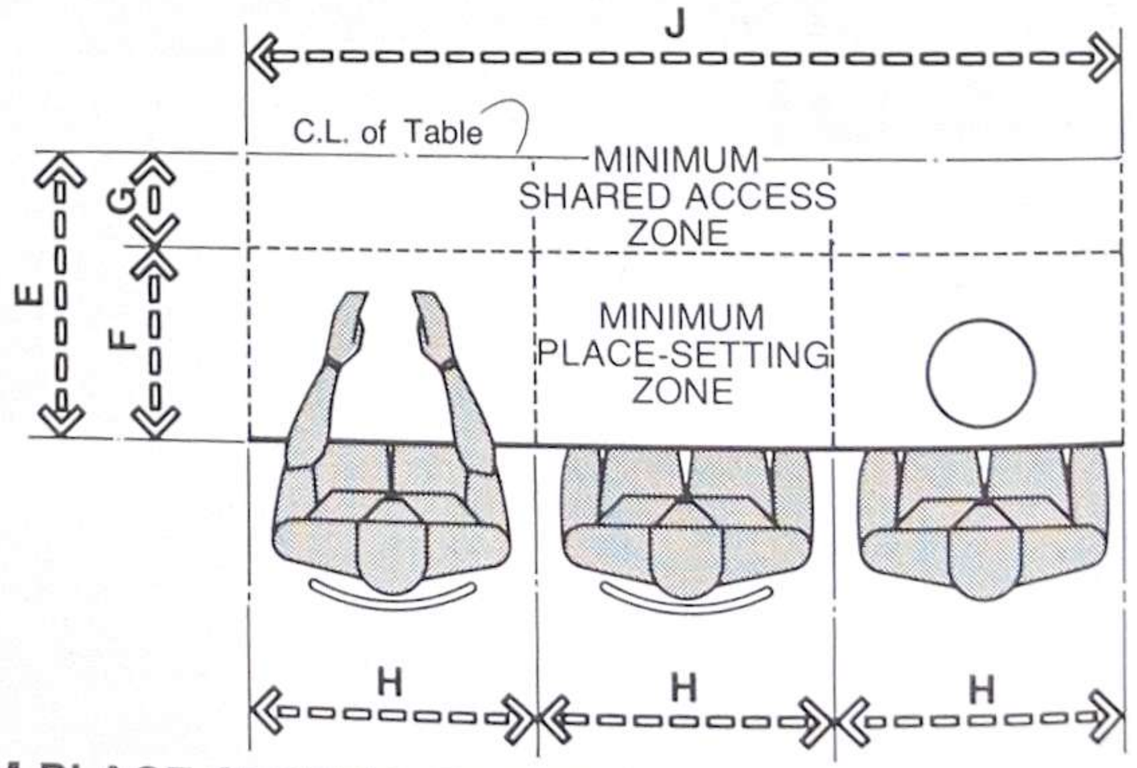
OPTIMUM PLACE SETTING



MINIMUM PLACE SETTING

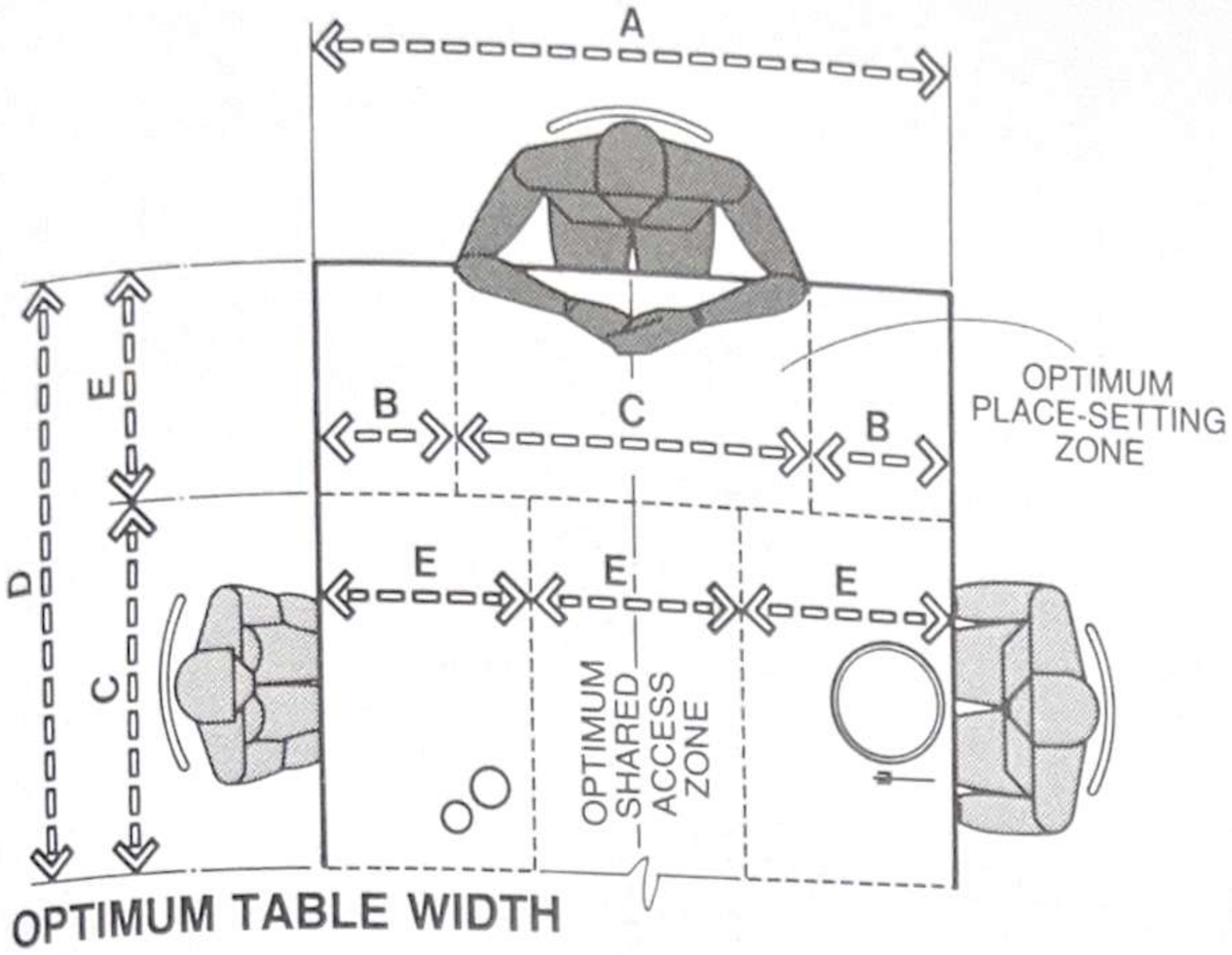


OPTIMUM PLACE SETTING FOR THREE

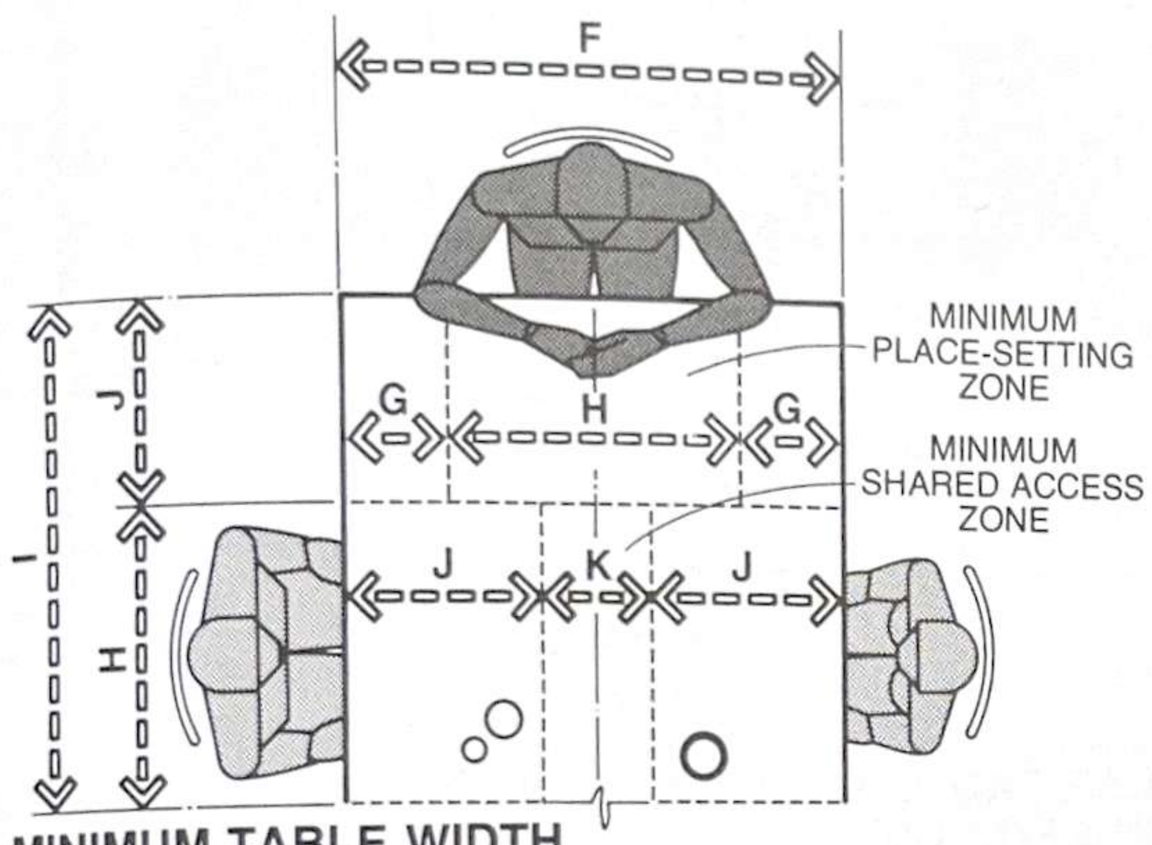


MINIMUM PLACE SETTING FOR THREE

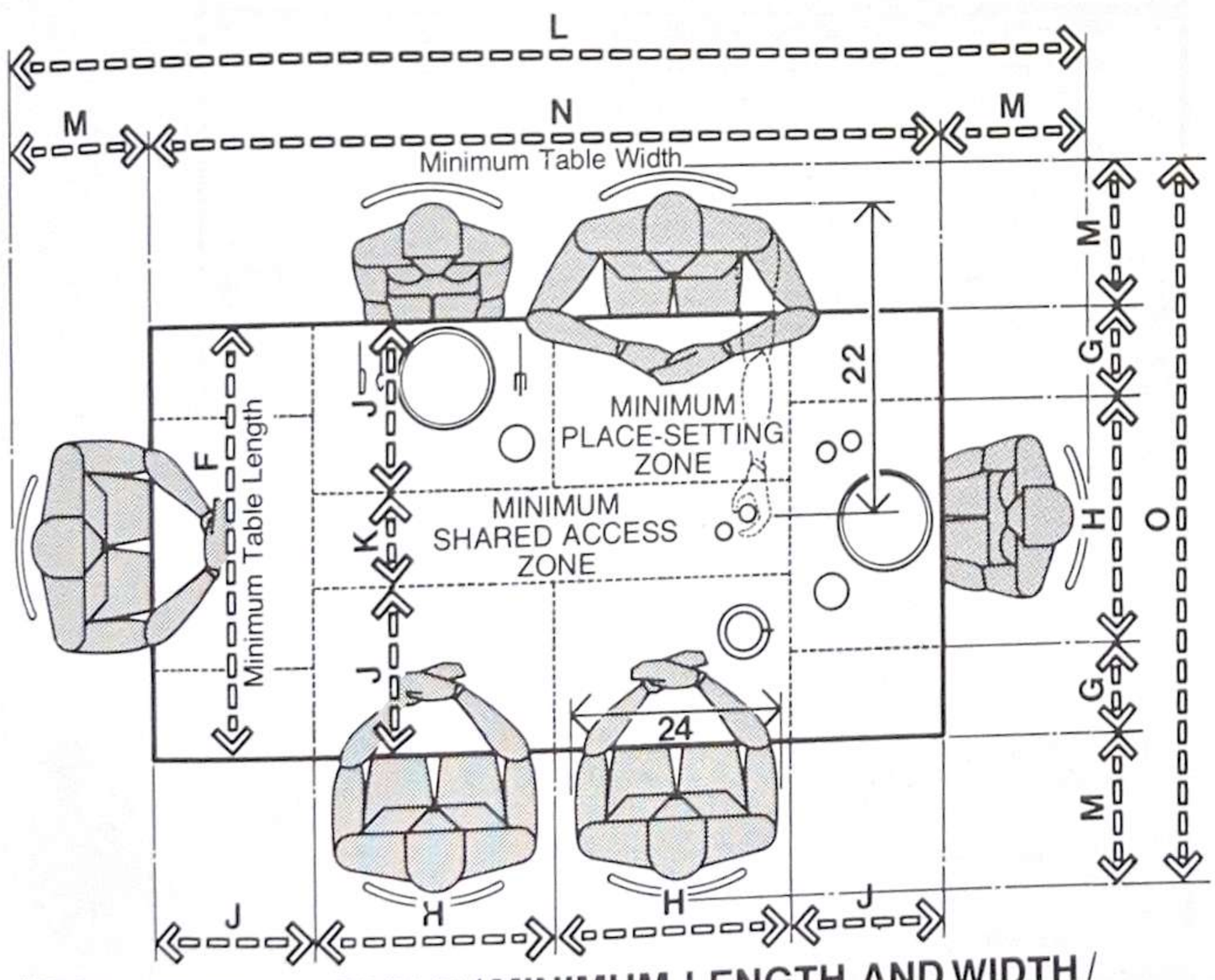
	in	cm
A	27	68.6
B	18	45.7
C	9	22.9
D	30	76.2
E	21	53.3
F	16	40.6
G	5	12.7
H	24	61.0
I	90	228.6
J	72	182.9



OPTIMUM TABLE WIDTH



MINIMUM TABLE WIDTH



RECTANGULAR TABLE / MINIMUM LENGTH AND WIDTH / DINING FOR SIX

function of lifestyle, type of meal, level of formality and sophistication, serving help available, nature of serving operation, occasion, and number of people. The optimal depth suggested if relatively formal and frequent dinner parties are involved is 18 in, or 45.7 cm. The minimal depth is about 10 in, or 25.4 cm. If half of the depth of this zone is allocated to the individual place setting zone, it is possible to arrive at an optimal and minimal incremental unit of area per diner that can be applied in determining table size to serve any given number of diners. The optimal unit so calculated becomes 30 by 27 in, or 76.2 by 68.6 cm, and the minimal unit 24 by 21 in, or 61 by 53.3 cm, respectively. The drawings on these two pages examine table sizes in terms of their optimal and minimal incremental units. The drawing at the top of the facing page illustrates the basic optimal and minimal units.

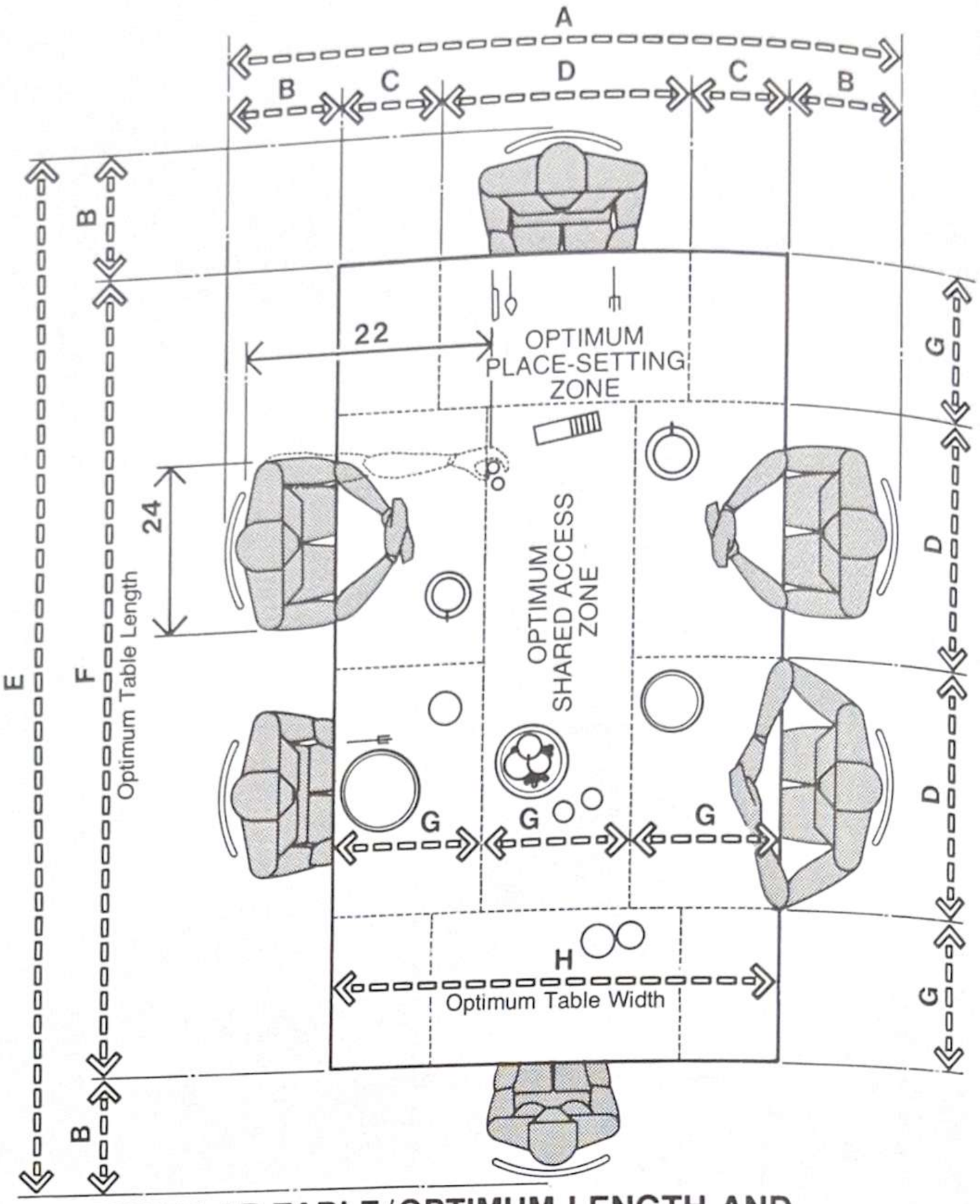
The bottom drawing illustrates each of the units arranged three in a row. The drawings at the top of this page illustrate the units arranged around the end of the table, while the bottom drawing illustrates a table for six based on a minimal increment. It should be noted that room size also dictates the size of the table. It is also possible to function with tables of less or certainly greater width. Dining tables of 36 in, or 91.4 cm, for example, are quite common. Much depends, however, on the level of comfort and convenience desired, which, within limits, becomes a matter of personal decision.

	in	cm
A	54	137.2
B	12	30.5
C	30	76.2
D	48	121.9
E	18	45.7
F	42	106.7
G	9	22.9
H	24	61.0
I	40	101.6
J	16	40.6
K	10	25.4
L	116–128	294.6–325.1
M	18–24	45.7–61.0
N	80	203.2
O	78–90	198.1–228.6

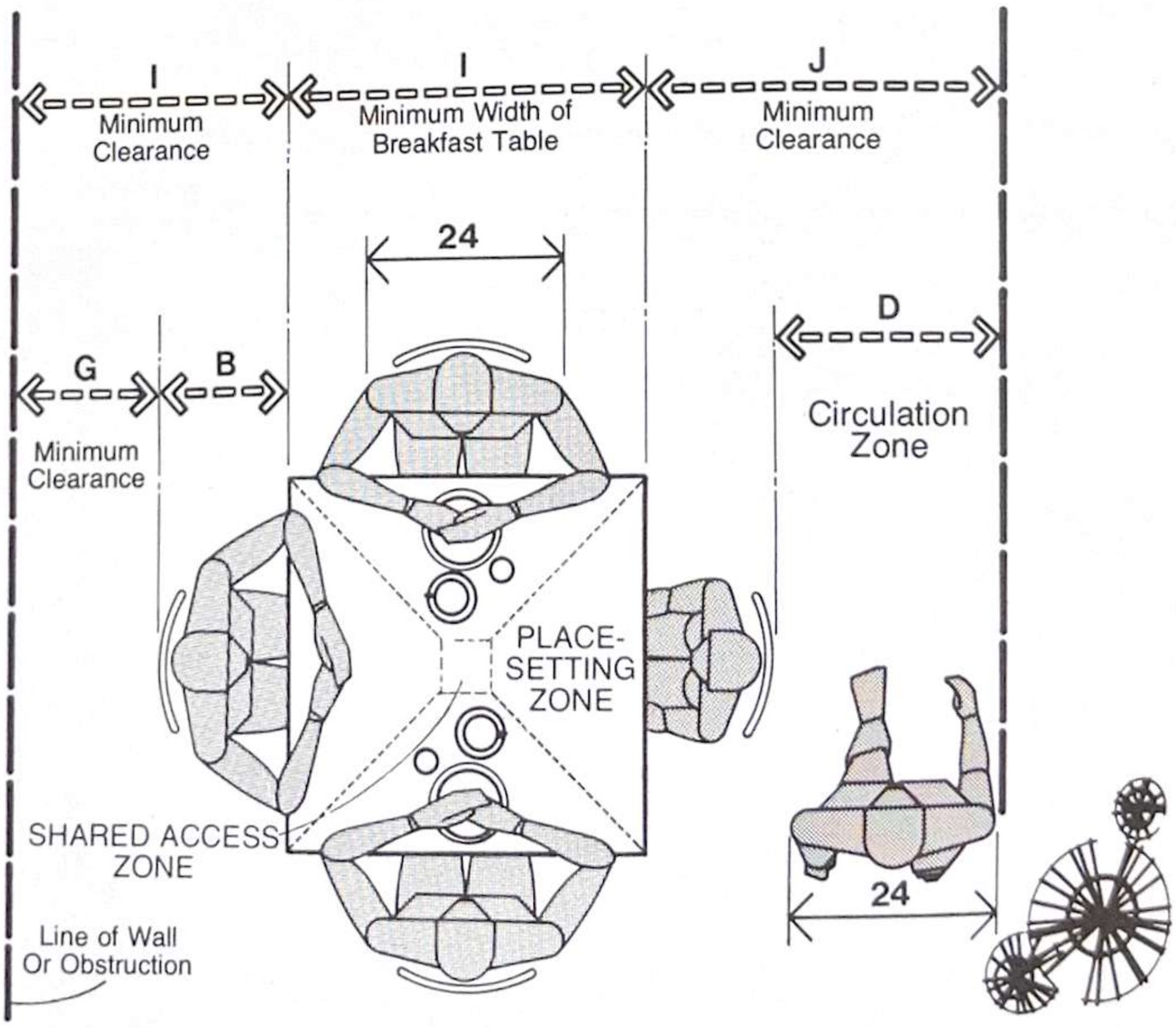
2.2 DINING SPACES

The top drawing applies the optimal incremental unit discussed on the preceding page to a rectangular table for formal dining for six. The table size shown is 54 by 96 in, or 137.2 by 243.8 cm. This size will provide each person with an individual place-setting zone of 18 by 30 in, or 45.7 by 76.2 cm, and will allow a shared access zone at the center of the table with a depth of 18 in. The 30-in width provided for each person allows for elbow room.

The bottom drawing, in contrast, shows a minimal, square general purpose table for informal dining. Although the width and depth of the place-setting zones are the same as in the larger rectangular tables, their angular configuration reduces the area significantly as well as the area of the shared access zone. To allow clearance for the chair and head-on circulation behind the chair, a minimum distance of 48 in, or 121.9 cm, must be maintained between the edge of the table and the wall or nearest physical obstruction. A clearance of 36 to 42 in, or 91.4 to 106.7 cm, can be provided to allow restricted circulation. This will require a person to sidestep or the seated person to adjust the chair to allow passage.



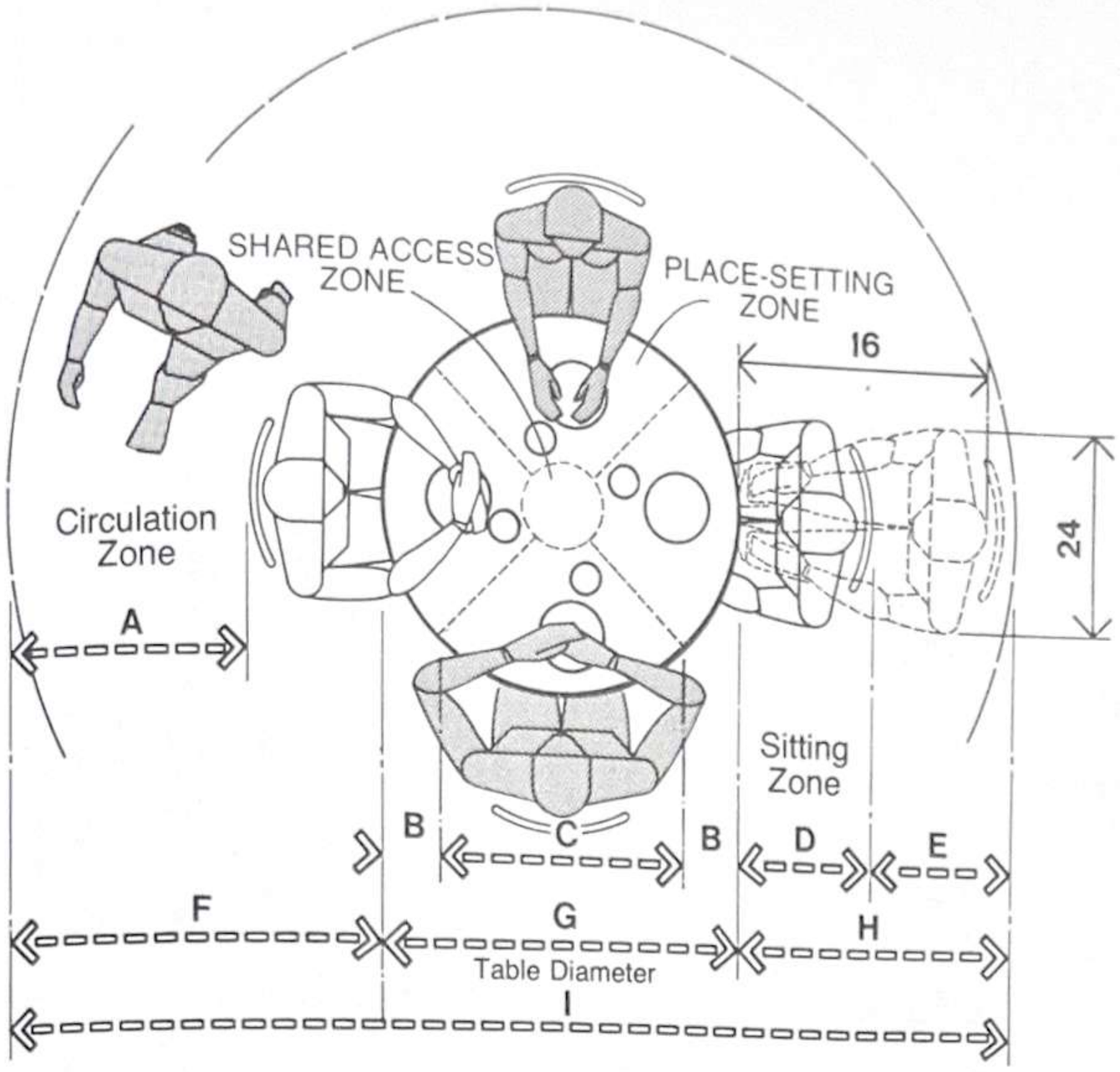
RECTANGULAR TABLE/OPTIMUM LENGTH AND WIDTH/DINING FOR SIX



BREAKFAST/KITCHEN TABLE FOR FOUR

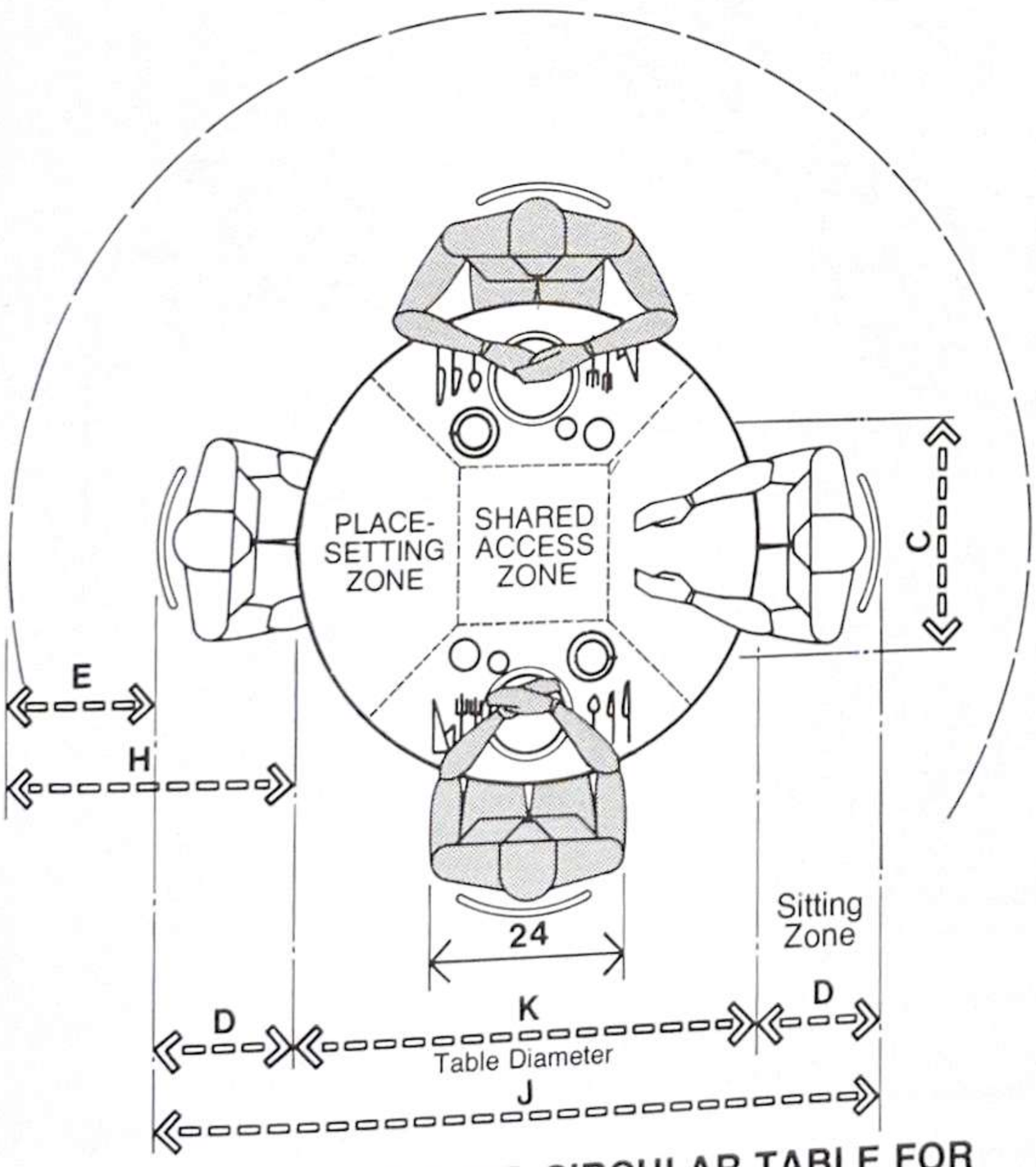
	in	cm
A	96–102	243.8–259.1
B	18–24	45.7–61.0
C	12	30.5
D	30	76.2
E	132–144	335.3–365.8
F	96	243.8
G	18	45.7
H	54	137.2
I	36–42	91.4–106.7
J	48 min.	121.9 min.
K	18 min.	45.7 min.

2.2 DINING SPACES



36-IN (91.4-CM) DIAMETER BREAKFAST/KITCHEN TABLE FOR FOUR

The top drawing illustrates a 36-in, or 91.4-cm, diameter round table seating four people and shows the necessary clearances around the perimeter. Four people cannot function comfortably around such a small table for anything but the lightest snacks. The individual place-setting zones are extremely restricted and the shared access zone at the center is too small to accommodate much in the way of serving dishes, platters, or decorative elements. A 48-in, or 121.9-cm, clearance between the perimeter of the table and the wall or nearest physical obstruction is the minimal clearance necessary to allow circulation behind a seated person. A distance of 30 to 36 in, or 76.2 to 91.4 cm, between the table perimeter and the wall is the minimum clearance necessary to permit access to and adjustment of the chair. The 48-in, or 121.9-cm, diameter table shown at the bottom of the page, however, can function adequately for four people. The place-setting zone is reasonably sufficient to accommodate the various place-setting elements and provides generous elbow room as well. Although the central shared access zone is restricted, it provides far more space than the 36-in, or 91.4-cm, diameter table shown above. If used for light snacks or coffee, the table can seat five. The clearances for circulation are the same as for the 36-in table.

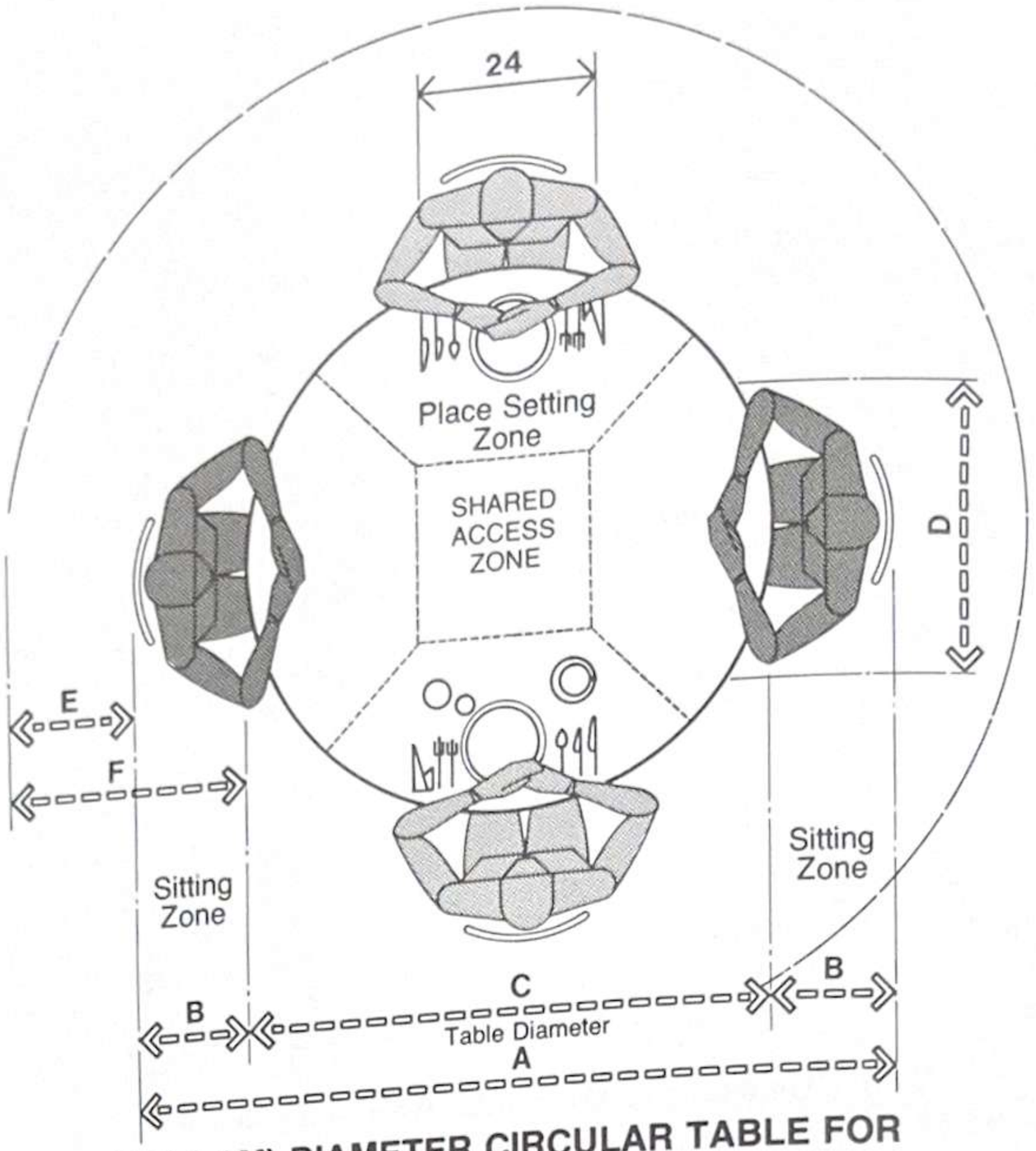


48-IN (121.9-CM) DIAMETER CIRCULAR TABLE FOR FOUR/MINIMUM SCHEME

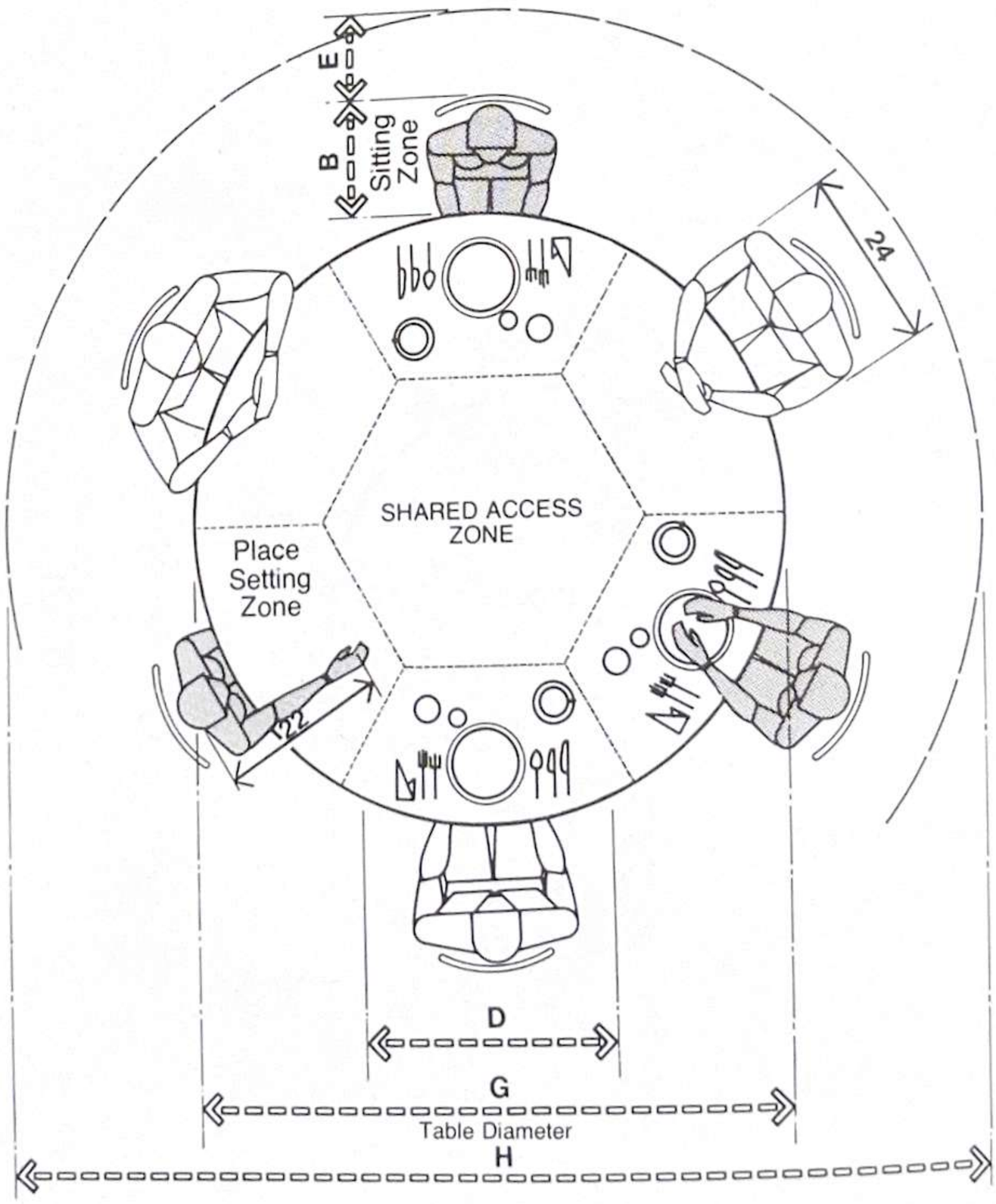
	in	cm
A	30 min.	76.2 min.
B	6	15.2
C	24	61.0
D	18–24	45.7–61.0
E	12	30.5
F	48–54	121.9–137.2
G	36	91.4
H	30–36	76.2–91.4
I	114–126	289.6–320.0
J	84–96	213.4–243.8
K	48	121.9

2.2 DINING SPACES

The optimal place-setting zone at the beginning of this section was established at 18 by 30 in, or 45.7 by 76.2 cm. The 60-in, or 152.4-cm, diameter table shown at the top of the page can easily, if not luxuriously, accommodate four such optimal zones. If perimeter were the only consideration, the table could easily accommodate six and possibly seven people. In the process, however, the area of the individual place-setting zone would fall below optimum size and into the minimal category. The advantage of the round table is its relative flexibility to accommodate additional people. The disadvantage is the floor area consumed. By comparison, a 60- by 66-in, or 152.4- by 167.6-cm, rectangular table, which could effectively occupy about the same floor area, can seat six people and provide each with an optimal place-setting zone of 18 by 30 in. The choice of a 60-in diameter table to seat four people would not be a wise decision. The 72-in, or 182.9-cm, diameter table to seat six people, with optimal place-setting zones, would, on balance, constitute a more sensible choice than a 60-in diameter table to serve four.



60-IN (152.4-CM) DIAMETER CIRCULAR TABLE FOR FOUR/OPTIMUM SEATING



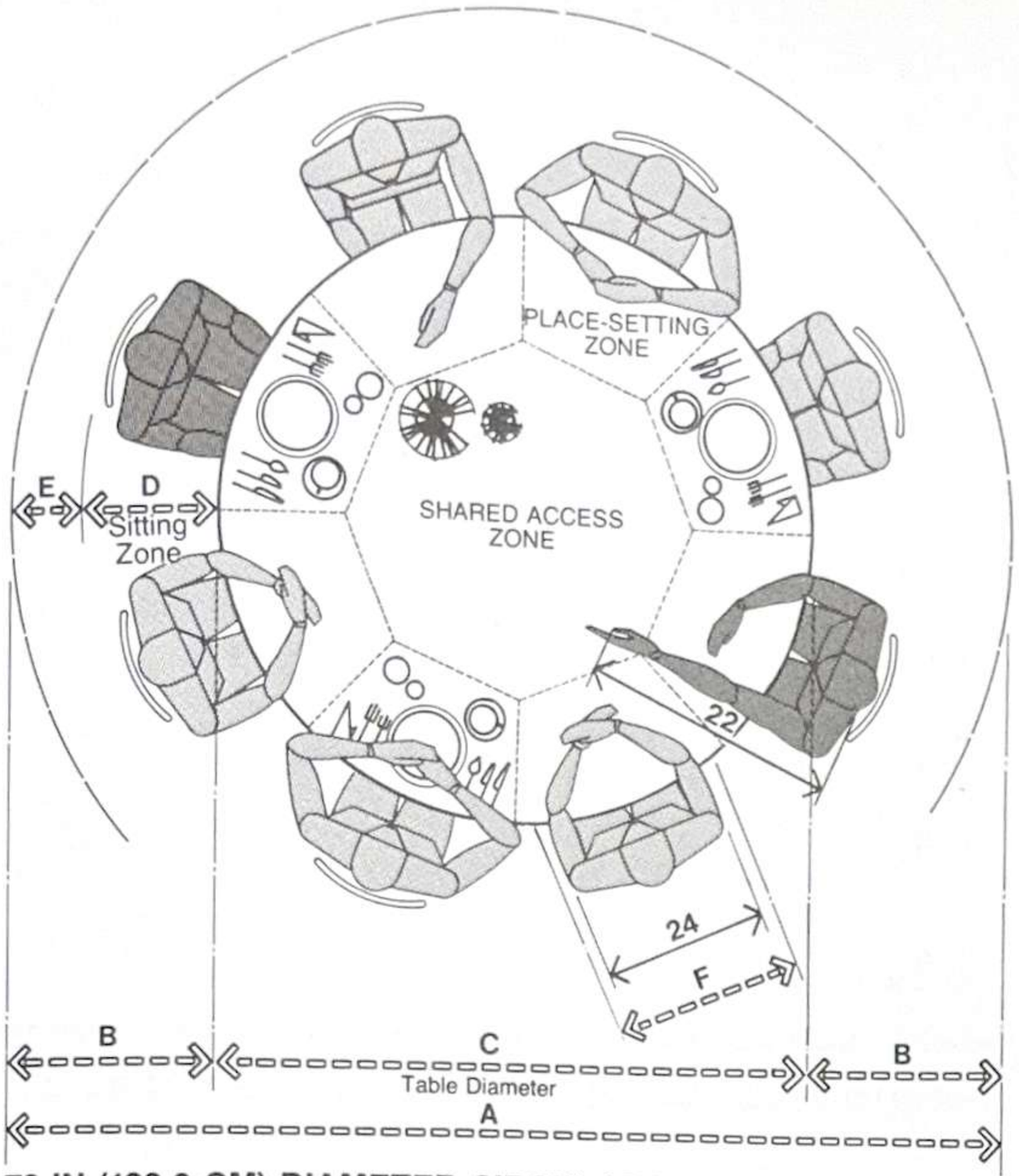
72-IN (182.9-CM) DIAMETER CIRCULAR TABLE FOR SIX/OPTIMUM SCHEME

	in	cm
A	96–108	243.8–274.3
B	18–24	45.7–61.0
C	60	152.4
D	30	76.2
E	12	30.5
F	30–36	76.2–91.4
G	72	182.9
H	132–144	335.3–365.8

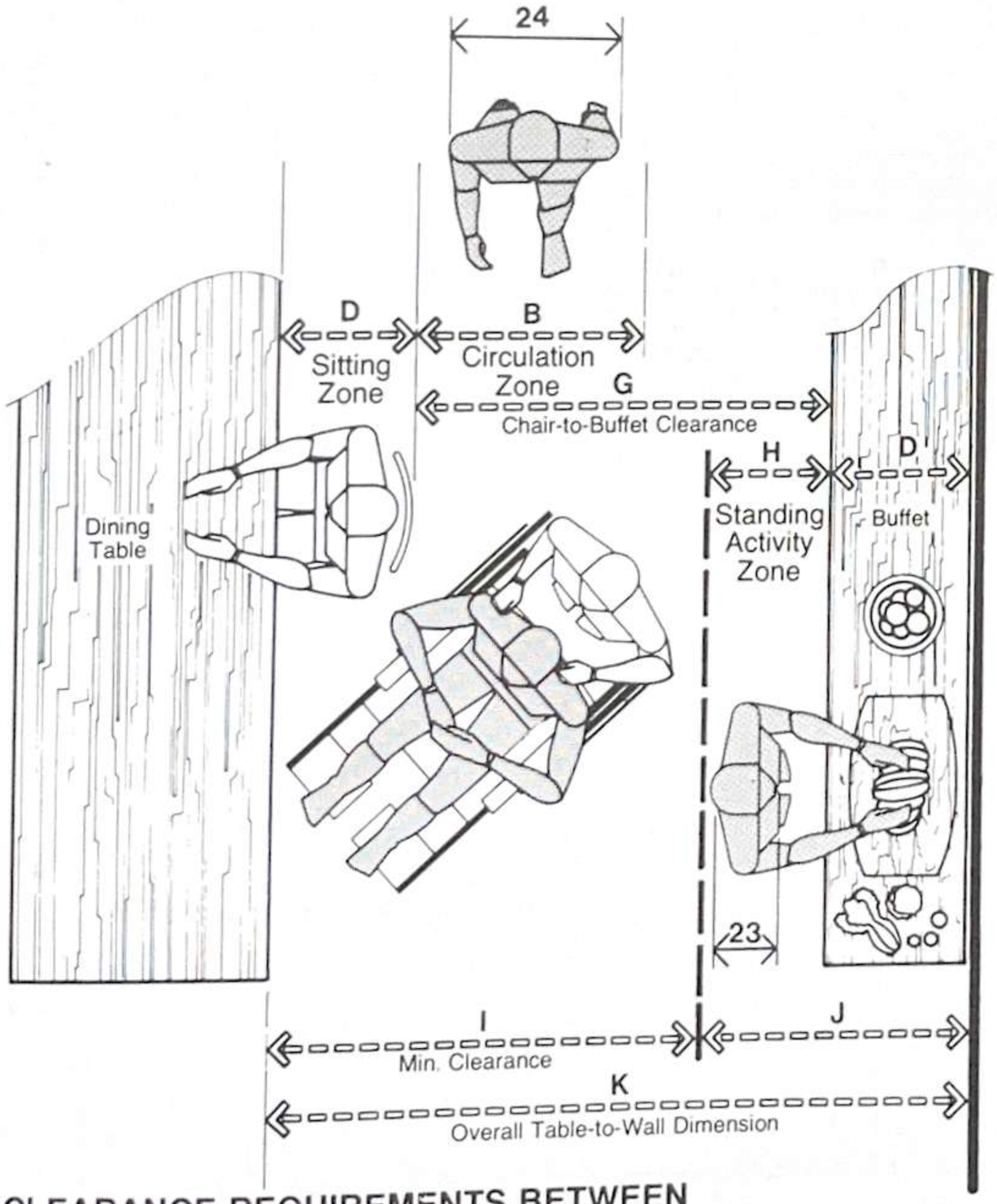
2.2 DINING SPACES

The top drawing shows a 72-in, or 182.9-cm, diameter table that seats eight people based on a minimal place-setting zone. Although the effective depth of the zone is less than provided in the optimal arrangement shown on the preceding page, the central shared access zone is greater.

The bottom drawing illustrates the clearance suggested for wheelchair access to the dining table and the space required by a person standing, arranging, or otherwise preparing food to be served.



72-IN (182.9-CM) DIAMETER CIRCULAR TABLE FOR EIGHT/MINIMUM SCHEME



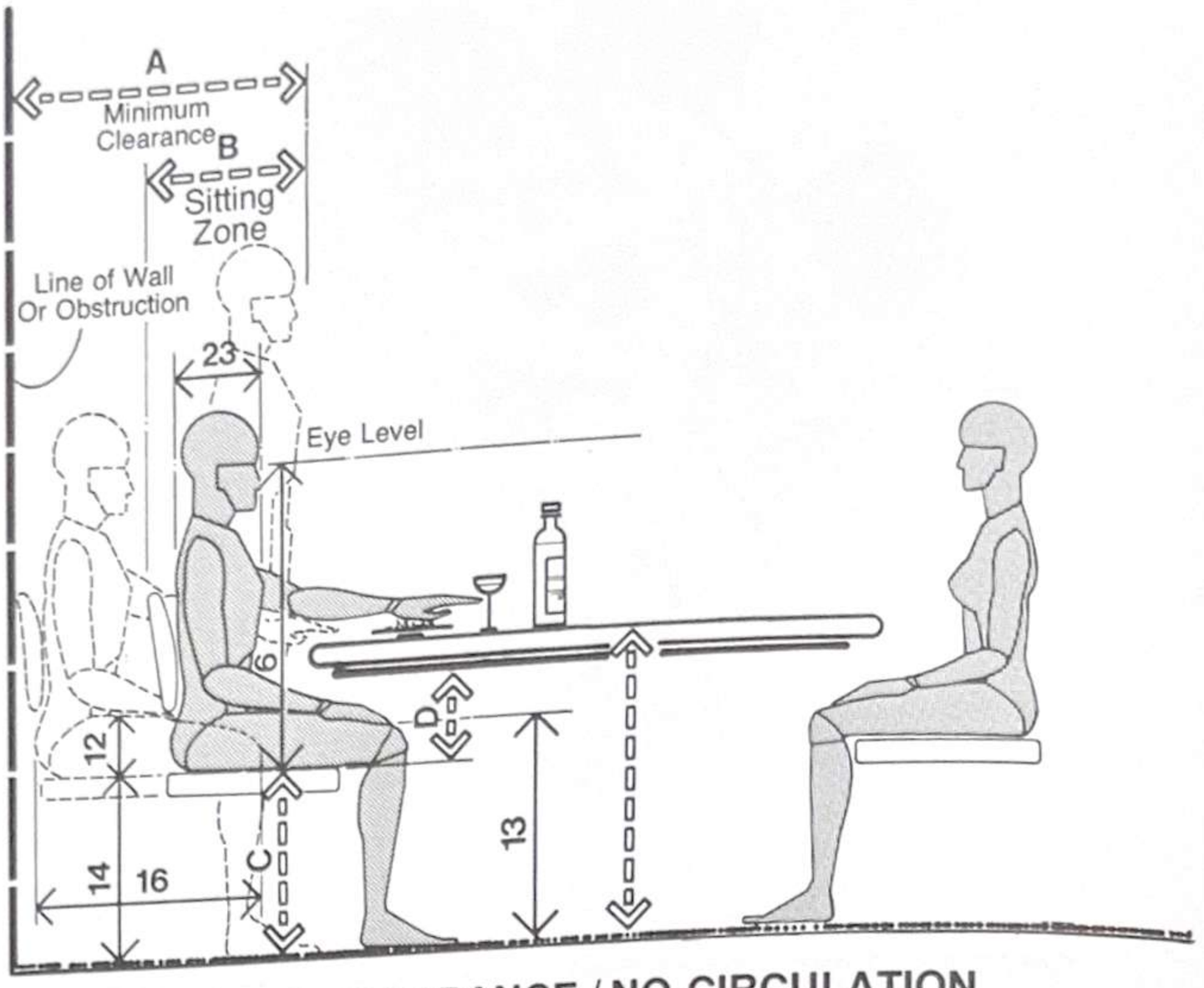
CLEARANCE REQUIREMENTS BETWEEN DINING TABLE AND BUFFET

	in	cm
A	132–144	335.3–365.8
B	30–36	76.2–91.4
C	72	182.9
D	18–24	45.7–61.0
E	12	30.5
F	24	61.0
G	50–54	127.0–137.2
H	50–60	127.0–152.4
I	54	137.2
J	86–102	218.4–259.1
K	90–96	228.6–243.8

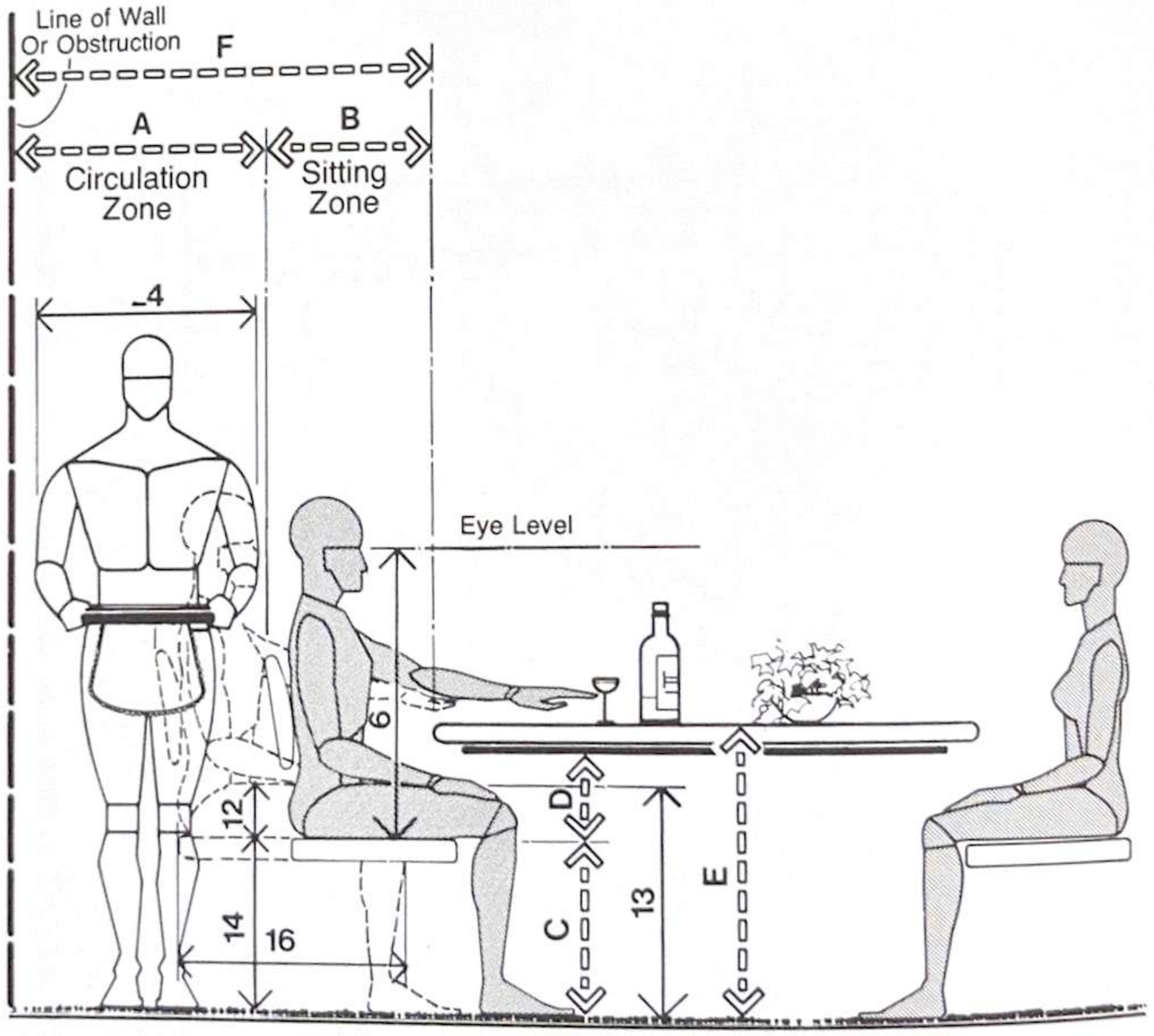
2.2 DINING SPACES

The relationship of the chair to the dining table is an important consideration. The top drawing explores two basic aspects of this relationship. The first is the various locations of the chair in relation to the table during the course of the meal and the clearances involved; the chair may be relocated as many as four times during the dining process. At the beginning, it is much closer to the table. Near the end of the meal, perhaps while the person is sipping coffee and attempting to relax by changing body position, the chair may be moved away from the table about 24 in, of 61 cm. Intimate conversation may cause the chair to be brought closer to the table than at the beginning. Finally, as the person rises from the chair at the conclusion of the meal, its final location may be as much as 36 in, or 91.4 cm away. The drawing indicates that the edge of the table should be at least 36 in, or 91.4 cm, away from the wall or nearest obstruction to accommodate all these movements. The height of the seat above the floor should allow the foot to rest firmly on the ground. If the seat height is too great, the foot will dangle and the area of the thigh just behind the knee will become pinched and irritated. A seat height of 16 to 17 in, or 40.6 to 41.3 cm, should be adequate to accommodate most people. Adequate clearance for the thigh should also be provided between the top of the seat and the underside of the table. As indicated on the drawing, 7.5 in, or 19.1 cm, is the minimum required. The backrest of the chair should be properly located to give support to the lumbar region of the back. The height of the table top from the floor should be between 29 and 30 in, or 73.7 to 76.2 cm. The bottom drawing indicates that to allow sufficient clearance for someone to pass or serve, the table should be located between 48 and 60 in, or 121.9 to 152.4 cm, from the wall.

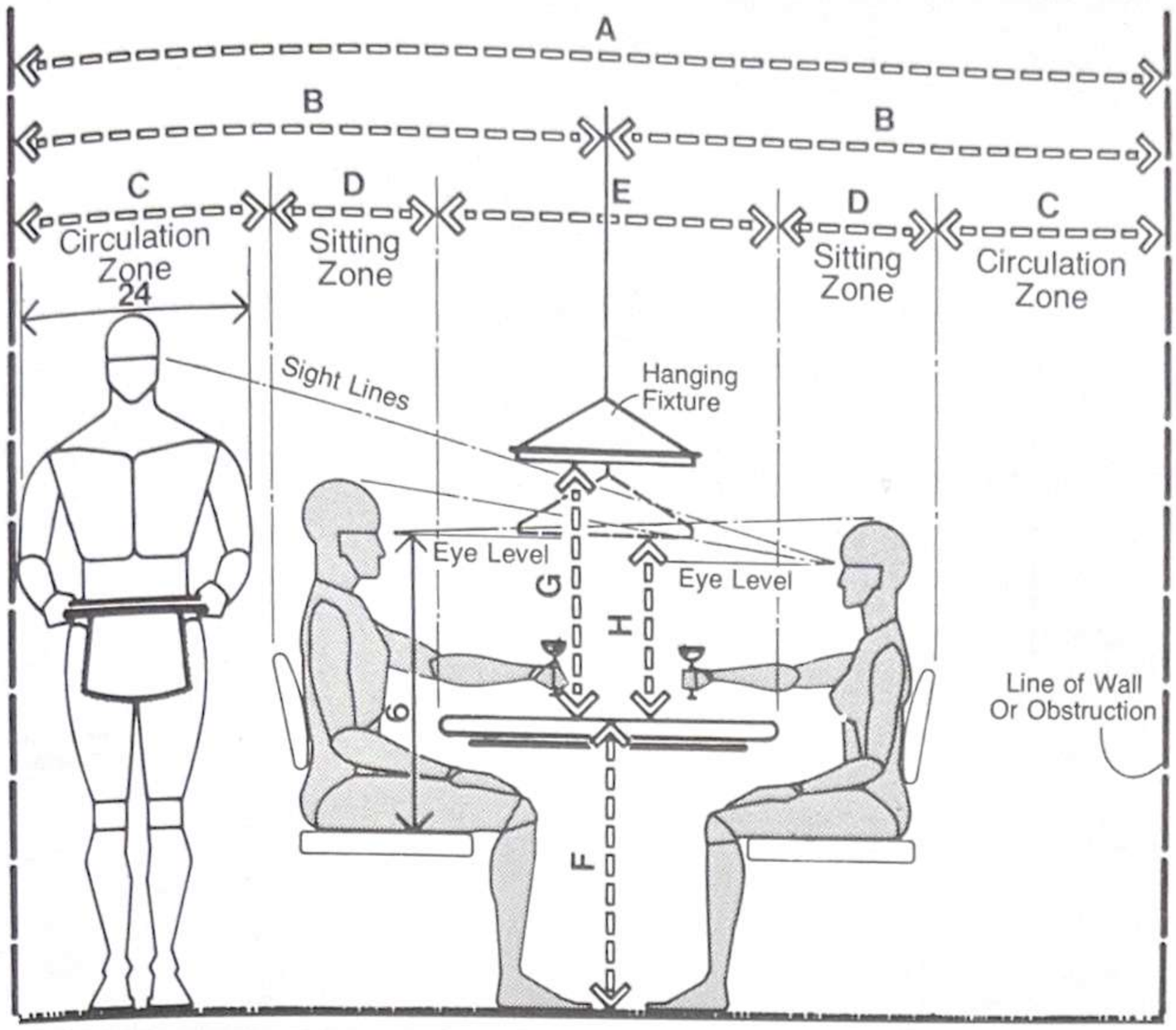
	in	cm
A	30–36	76.2–91.4
B	18–24	45.7–61.0
C	16–17	40.6–43.2
D	7.5 min.	19.1 min.
E	29–30	73.7–76.2
F	48–60	121.9–152.4



MINIMUM CHAIR CLEARANCE / NO CIRCULATION



MINIMUM CLEARANCE BEHIND CHAIR IN PLACE

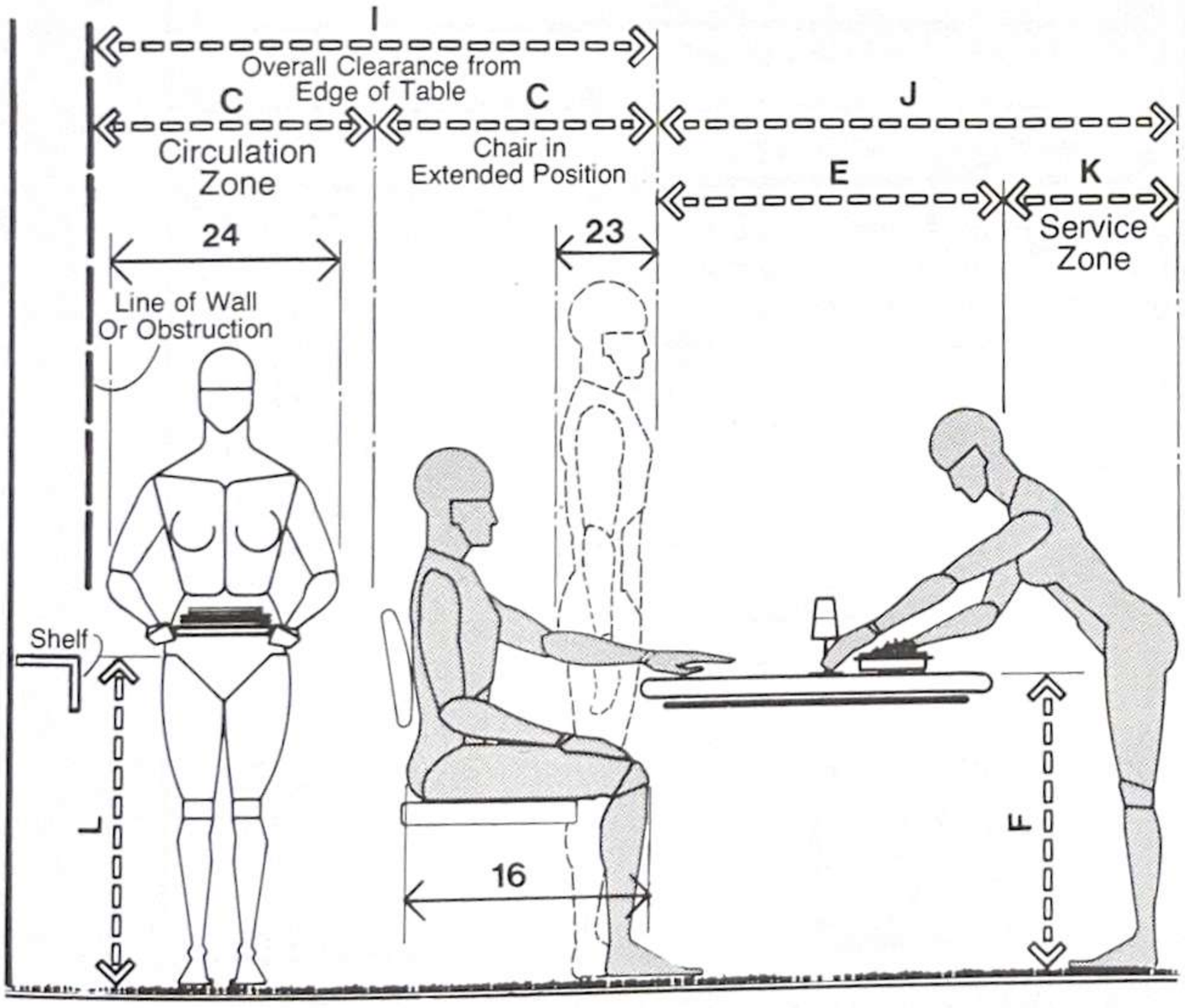


MINIMUM DINING AREA WIDTH

2.2 DINING SPACES

The proper height of a chandelier or other type of pendant lighting fixture above a dining table should be based on human dimension to ensure that it does not obstruct vision. The top drawing shows the relationship of fixture height above the table surface to a small and a large person. Eye height sitting is the body measurement to consider anthropometrically. The ideal solution is an adjustable arrangement so that the height of the fixture can be regulated to respond to personal preferences. The information on the drawing is useful in establishing initial height parameters as a basis for preliminary design assumptions. The drawing also indicates a minimal clearance between the table and the wall 48 in, or 121.9 cm, with the chair minimally extended from the table to permit one-lane service circulation behind the seated person.

The bottom drawing provides additional clearance information and suggests a minimum distance of 60 in, or 152.4 cm, between table and wall to accommodate one-lane head-on circulation with the chair extended a maximum distance from the table.

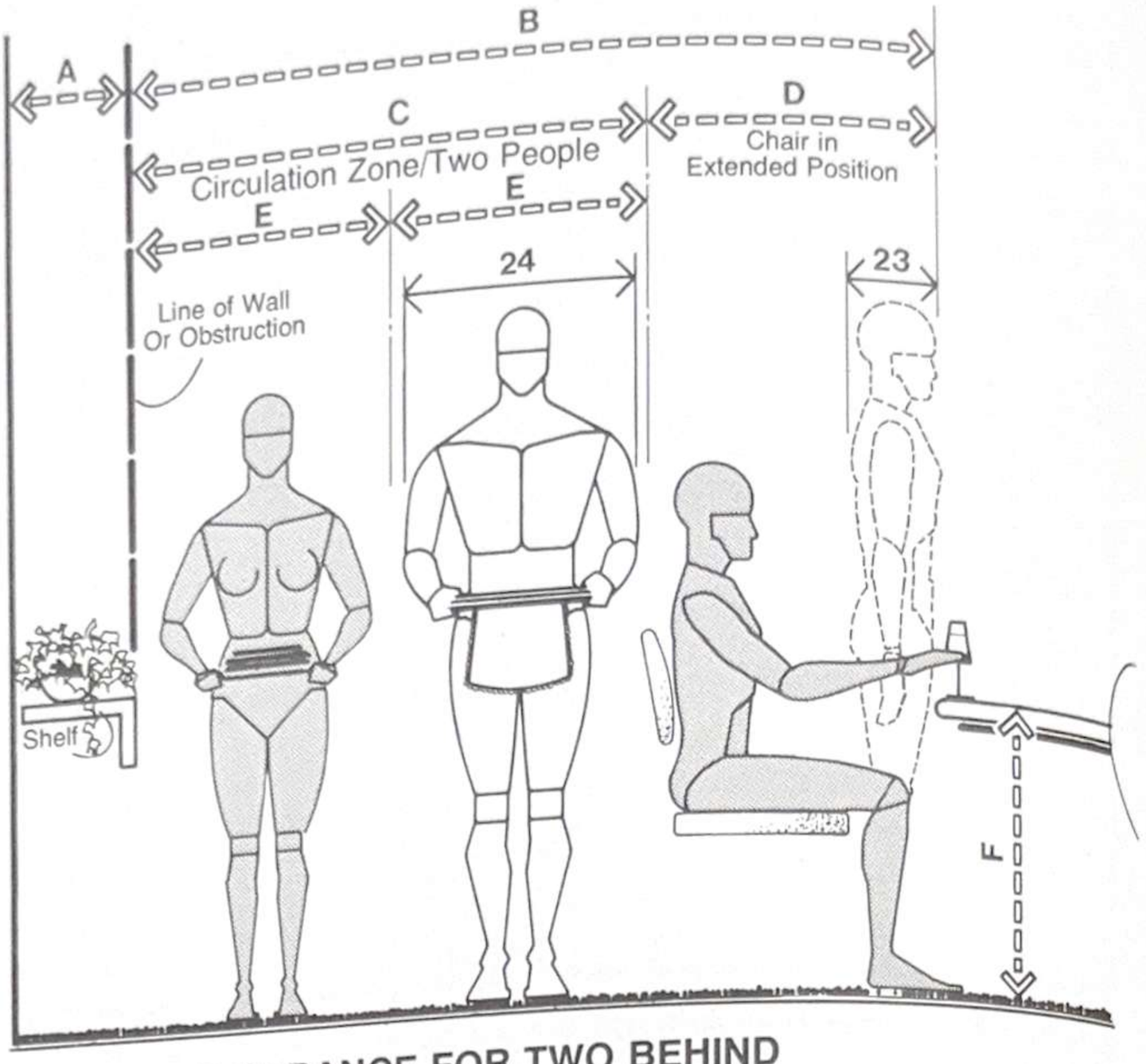


MINIMUM CLEARANCE BEHIND EXTENDED CHAIR

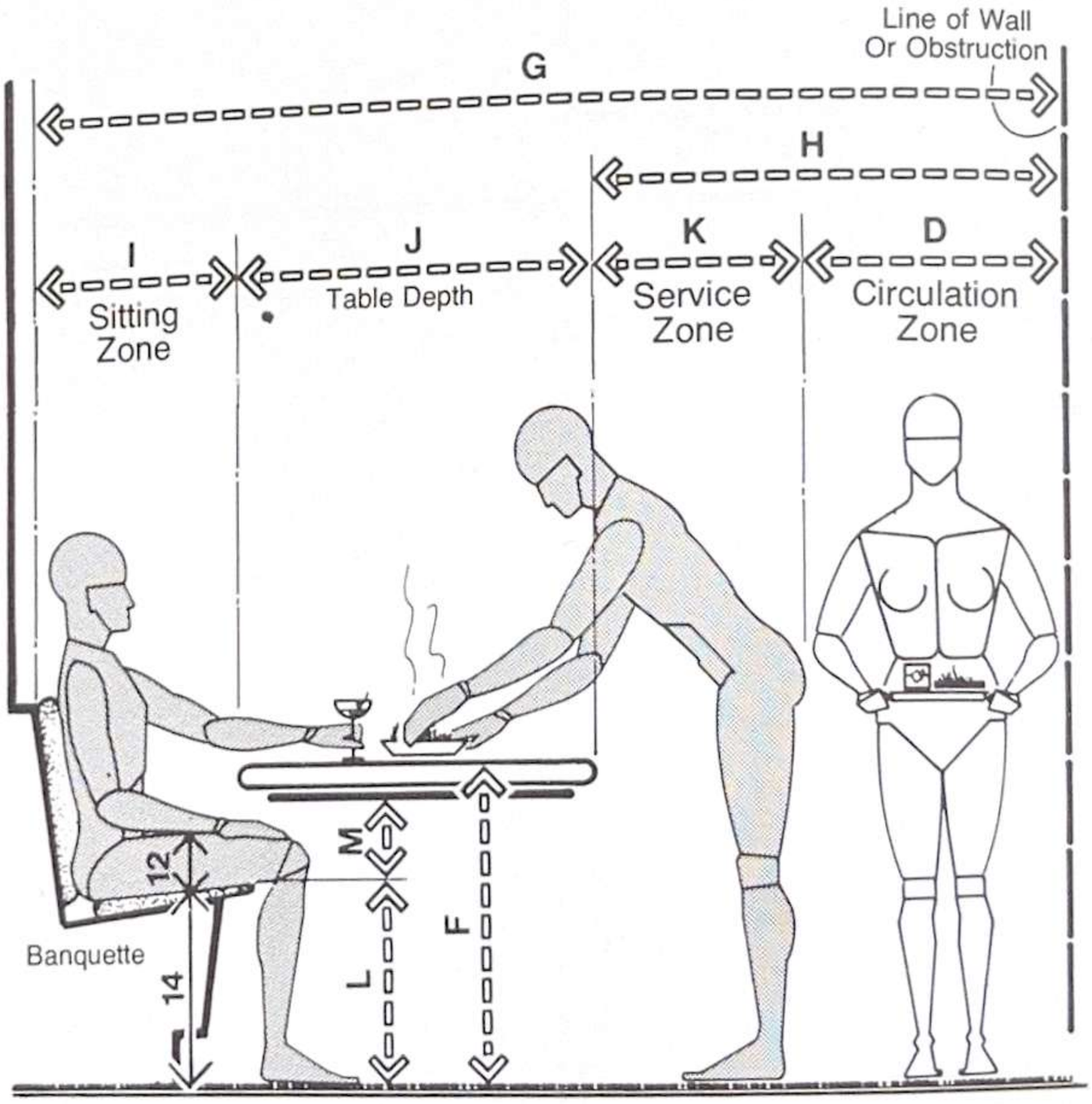
	in	cm
A	132–162	335.3–411.5
B	66–81	167.6–205.7
C	30–36	76.2–91.4
D	18–24	45.7–61.0
E	36–42	91.4–106.7
F	29–30	73.7–76.2
G	27	68.6
H	19	48.3
I	60–72	152.4–182.9
J	54–60	137.2–152.4
K	18	45.7
L	29–36	73.7–91.4

2.2 DINING SPACES

The top drawing shows clearances between the edge of the table and the wall or nearest physical obstruction to allow two-lane service circulation behind the chair, with the chair away from the table. The individual clearances shown require the table to be located 90 to 96 in, or 228.6 to 243.8 cm, from the wall. This clearance is generous for the average residential situation, given minimal room sizes available. It should be noted that in other arrangements illustrated on the preceding pages, a compressed minimal clearance permitting head-on one-lane circulation behind the seated person, with the chair minimally extended from the table, was established at 48 in, or 121.9 cm. The bottom drawing illustrates clearances required in a banquette arrangement where seating is located at one side only. The key body measurements to consider anthropometrically in most clearance situations is the maximum body breadth and maximum body depth of the larger person.



MINIMUM CLEARANCE FOR TWO BEHIND EXTENDED CHAIR



	in	cm
A	12–18	30.5–45.7
B	90–96	228.6–243.8
C	60	152.4
D	30–36	76.2–91.4
E	30	76.2
F	29–30	73.7–76.2
G	101.5–110	257.8–279.4
H	48–54	121.9–137.2
I	17.5–20	44.5–50.8
J	36	91.4
K	18	45.7
L	16–17	40.6–43.2
M	7.5 min.	19.1 min.

BANQUETTE SEATING/SERVICE AND PASSAGE CLEARANCE REQUIREMENTS

2.3 SLEEPING SPACES

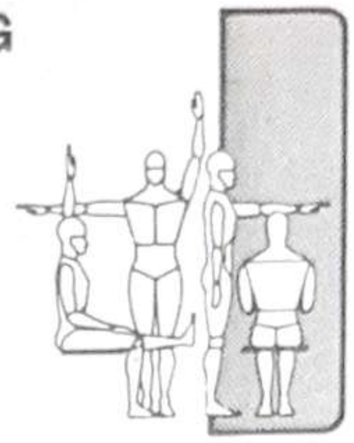


TABLE	SLEEPING	CIRCULATION	STORAGE	MAKE-UP AND DESK	VISUAL	ACTIVITIES / ANTHROPOMETRIC DATA
1A,2B	●		◑			1 STATURE
1B,3C			◑	●	◑	2 EYE HEIGHT
1D,2C	●					4 SITTING HEIGHT ERECT
1F,3G				○	◑	6 EYE HEIGHT SITTING
1L,2H				●		12 THIGH CLEARANCE
1M,2I				●		13 KNEE HEIGHT
1N,2J	◑			◑		14 POPLITEAL HEIGHT
1P,2L				●		16 BUTTOCK-KNEE LENGTH
1W,6B		●				23 MAXIMUM BODY DEPTH
1X,6A	●	●	●			24 MAXIMUM BODY BREADTH

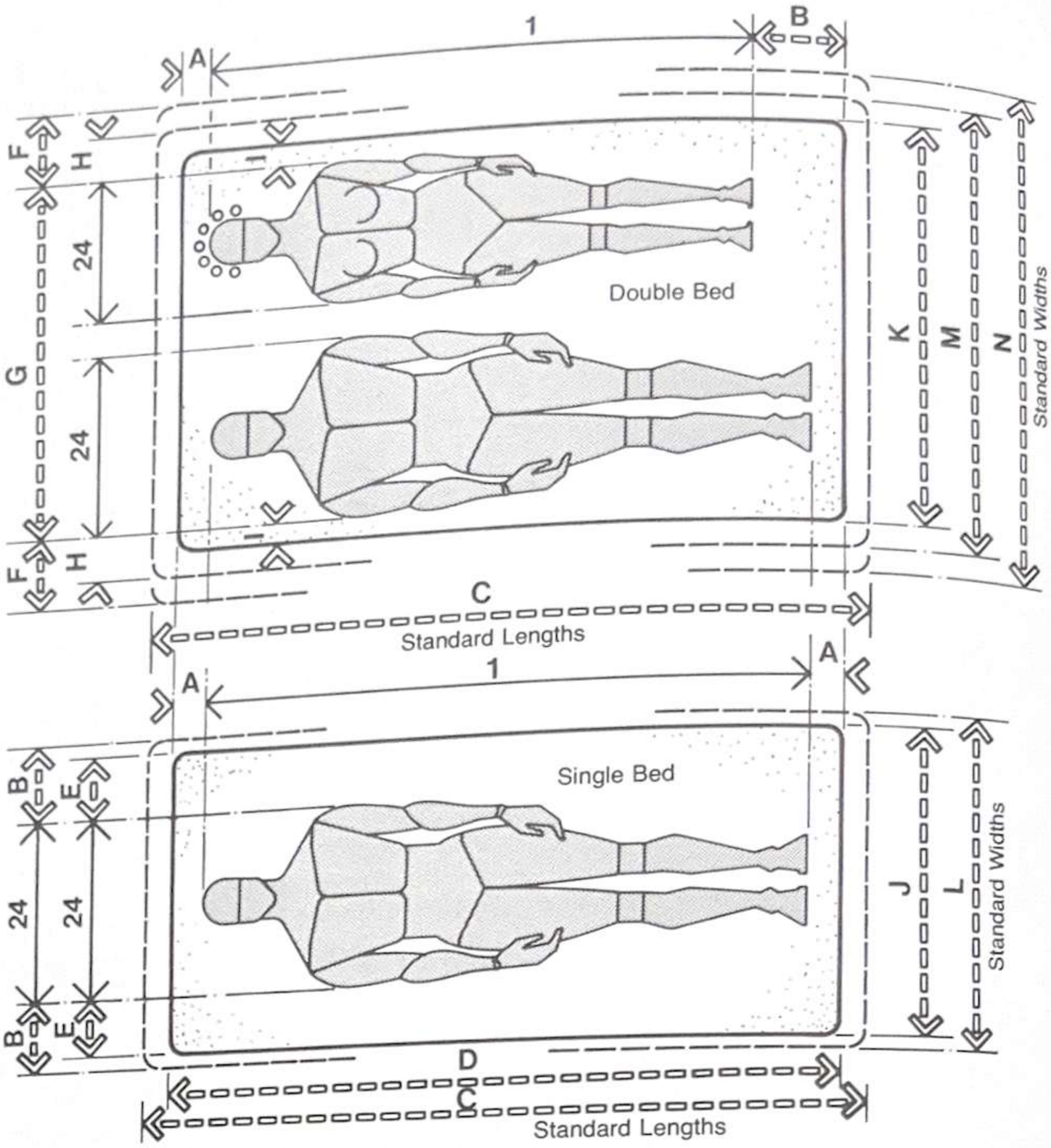
The drawings on the following pages explore the relationship of human dimension to the various components of sleeping spaces, the most obvious being the bed itself, both in its conventional form and in its overhead space-saving design. Often if a designer is preoccupied with glamorizing the sleeping environment, some of the more basic anthropometric considerations are ignored. Is there adequate space around the bed not only to circulate but to make it or vacuum under it? Is there adequate clearance between the bed and a dresser, with a drawer extended for circulation? If a view to the exterior of the space is important, what impact does the sill height have on the sight lines with the human body in a reclining position? In the design of a bunk or loft bed, how much clearance is required from the top of the lower bed to the bottom of the bed above to accommodate the human body in a seated position? How much clearance should be allowed between rows of hanging garments in a walk-in closet for comfortable human access? How high should a storage shelf be located to be within reach? How high should the mirror be over a dressing table for comfortable use?

Templates and rules of thumb as aids in designing the space can often be misleading. What can be equally misleading is for the designer to use himself or herself as a model in an attempt to simulate conditions related to reach and clearance situations, since what may accommodate the designer, may not accommodate the majority of users. The following drawings examine human body size, in relation to the various design situations mentioned, in terms of the anthropometric considerations indicated in the above matrix.

2.3 SLEEPING SPACES

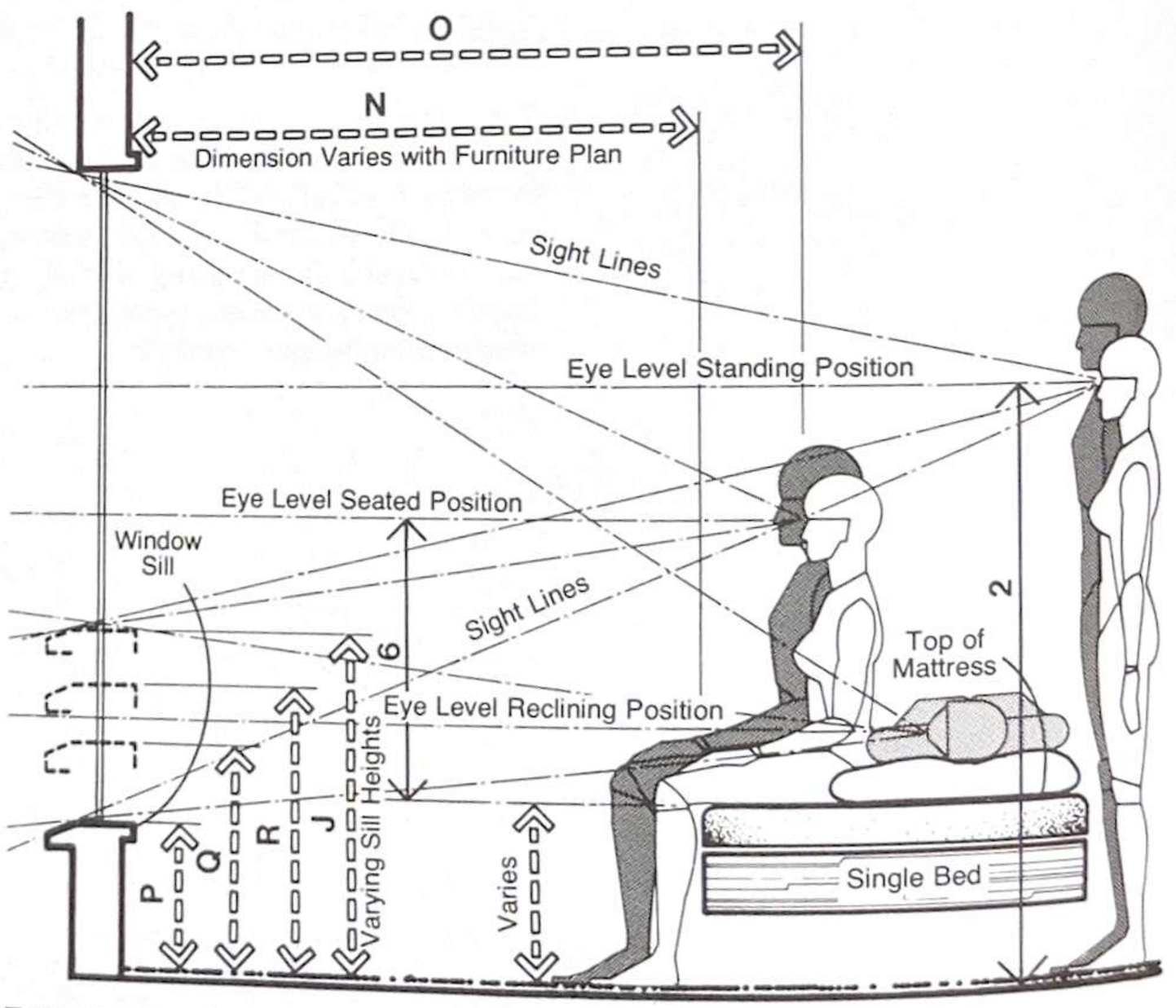
The top drawings illustrate standard variations of the typical single and double bed. The figures are shown simply to provide some approximation of the space required by the human body in relationship to the bed area. The drawings should not be taken too literally. The body positions assumed while sleeping may, in fact, take up far more space than shown. The clearances indicated to the edges of the bed are also quite academic and are intended only to provide a better sense of the bed sizes available and the general relationship of body size to bed size.

The relationship between sight lines and the sill or head of a window is critical if a view to the outside is a design consideration. The drawing at the bottom of the page shows the relationships of eye height in sitting, standing, and reclining positions to varying sill heights.

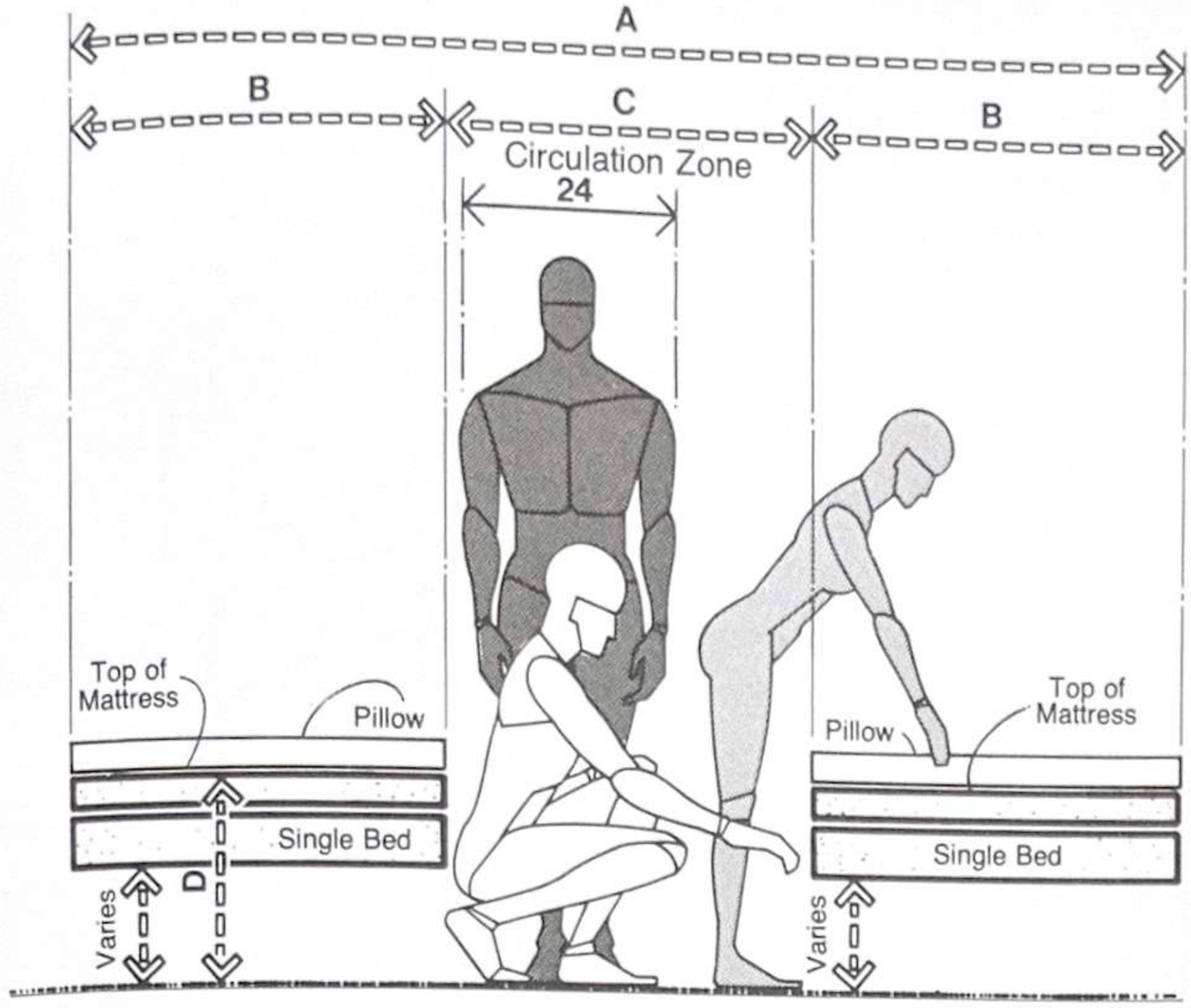


SINGLE AND DOUBLE BEDS

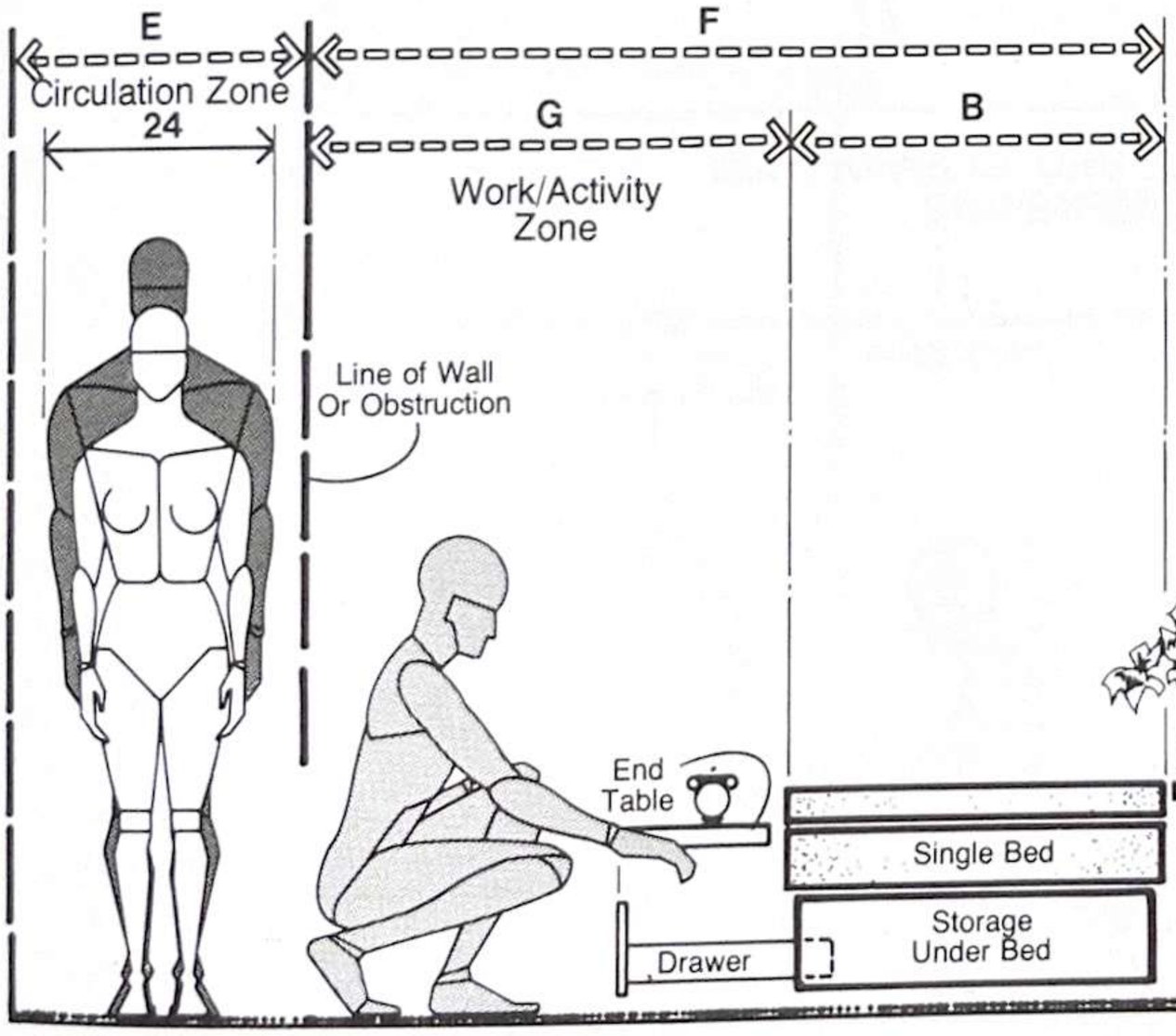
	in	cm
A	2.5	6.4
B	7.5	19.1
C	84	213.4
D	78	198.1
E	6	15.2
F	7–8	17.8–20.3
G	44–46	111.8–116.8
H	4–5	10.2–12.7
I	1–2	2.5–5.1
J	36	91.4
K	48	121.9
L	39	99.1
M	54	137.2
N	60	152.4
O	70	177.8
P	16	40.6
Q	22	55.9
R	30	76.2



BEDROOM / VISION AND SIGHT LINES



TWIN BED / CLEARANCES AND DIMENSIONS



SINGLE BED / CLEARANCES AND DIMENSIONS

2.3 SLEEPING SPACES

The top drawing illustrates the clearances suggested between single beds to allow for circulation, access, and making up the beds. A minimum of 36 in, or 91.4 cm, is recommended.

To conserve space, underbed storage may be used in many instances. In such situations, it is essential that adequate clearance be provided between the bed and the wall or the nearest physical obstruction to ensure comfortable access.

As indicated in the bottom drawing, a clearance of 46 to 62 in, or 116.8 to 157.5 cm, should be adequate to accommodate the human body in a kneeling position as well as the projection of a partially extended drawer. If it is necessary to provide for circulation that must by-pass the work/activity zone shown, an additional 30 in, or 76.2 cm, should be added.

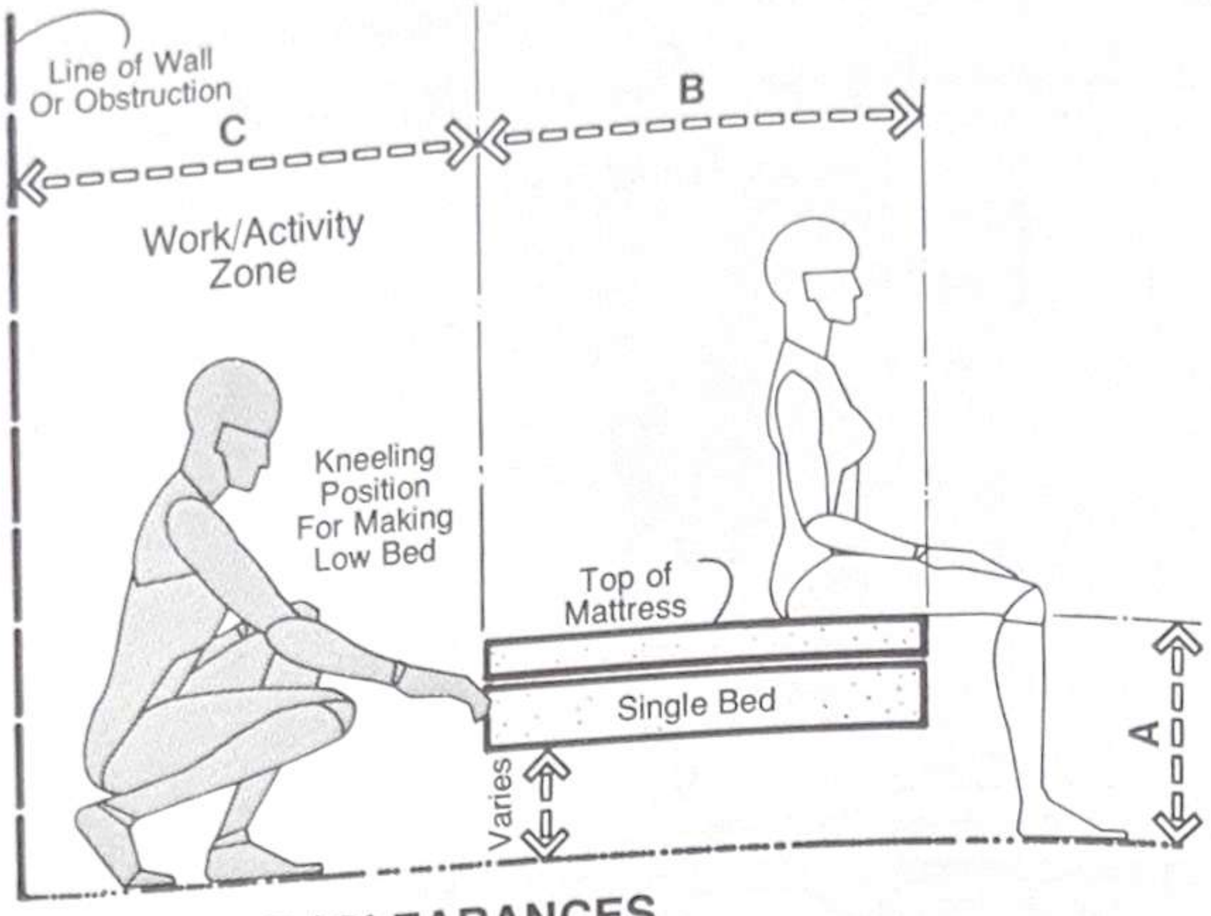
	in	cm
A	108–114	274.3–289.6
B	36–39	91.4–99.1
C	36	91.4
D	18–22	45.7–55.9
E	30	76.2
F	82–131	208.3–332.7
G	46–62	116.8–157.5

2.3 SLEEPING SPACES

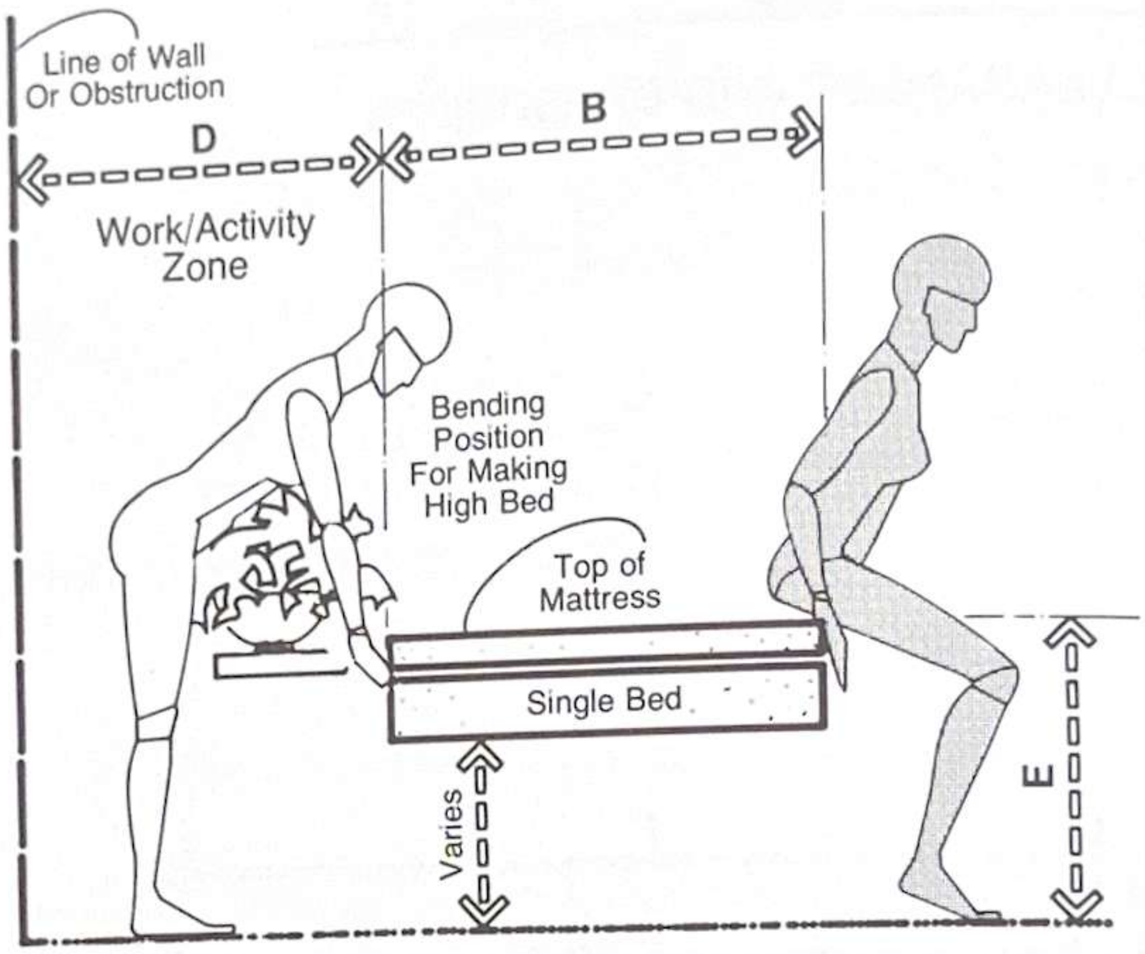
The three drawings on the page show the clearances involved in various bed-related work activities. The drawing at the top of the page illustrates a kneeling activity which would require a clearance of 37 to 39 in, or 93 to 99 cm, where a bed of low height is involved. Bed making usually results in backache because of the body position required to reach the bed surface. If the height of the bed were located about 24 in, or 61 cm, above the floor, as shown in the center drawing, the strain on the back would be greatly reduced. Such a height, however, does not accommodate the seated user comfortably, as suggested by the rather awkward body position of the seated figure.

In any event, a clearance of 26 to 30 in, or 66 to 76.2 cm, related to the higher bed height, is recommended to accommodate the bed-making activity.

The lower drawing illustrates the clearances involved for vacuuming under the bed. A workzone of 48 to 54 in, or 121.9 to 137.2 cm, is suggested to accommodate this activity. It should be noted that the vacuum cleaner is intentionally shown located outside the workzone merely to stress that the clearance is not overly generous. The cleaner can be located at the side of the user or even a considerable distance away. The configuration of the room and length, type, and flexibility of the cleaning device will all impact on the clearances required.

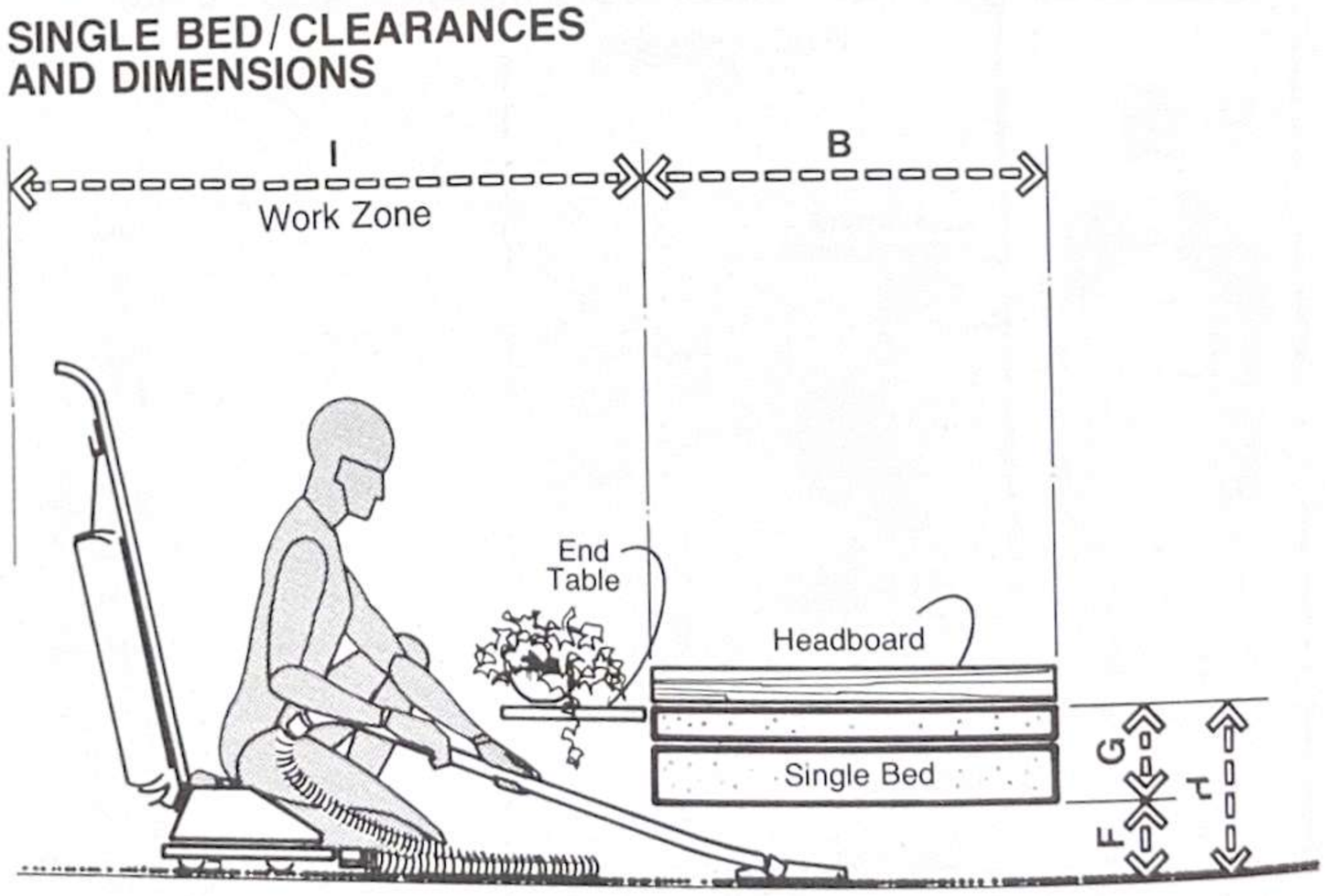


SINGLE BED / CLEARANCES AND DIMENSIONS



SINGLE BED / CLEARANCES AND DIMENSIONS

	in	cm
A	16	40.6
B	36–39	91.4–99.1
C	37–39	94.0–99.1
D	26–30	66.0–76.2
E	24	61.0
F	6–8	15.2–20.3
G	12–16	30.5–40.6
H	18–24	45.7–61.0
I	48–54	121.9–137.2

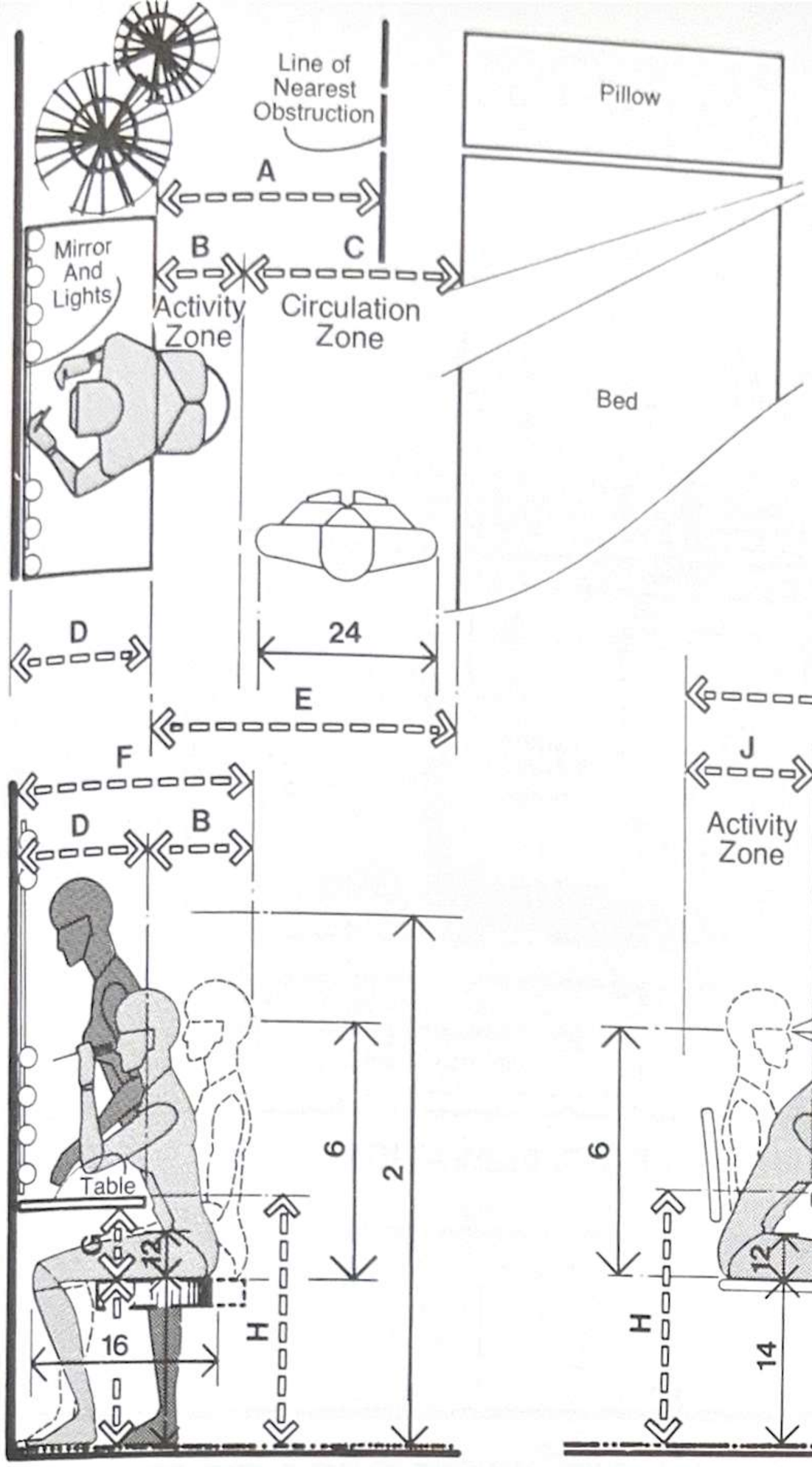


CLEANING REQUIREMENTS

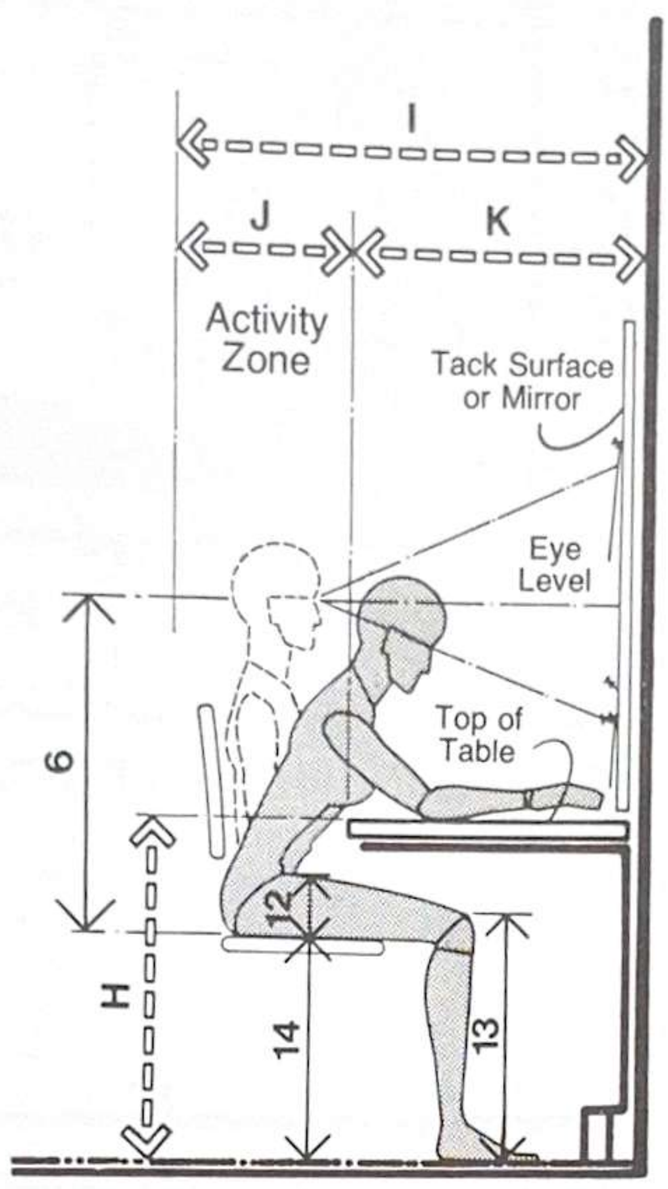
2.3 SLEEPING SPACES

The drawings at the top and center deal with clearances required by the human body in relation to dressing tables and desks. The drawing at the top shows the minimum clearance suggested between the dressing table and the bed or other physical obstruction to be 24 to 28 in, or 61 to 71.1 cm, if no circulation is required. Such a clearance simply allows for access to the table and for necessary movements and changes in chair position. To accommodate both circulation and dressing table activities, however, requires a clearance between 42 and 46 in, or 106.7 to 116.8 cm.

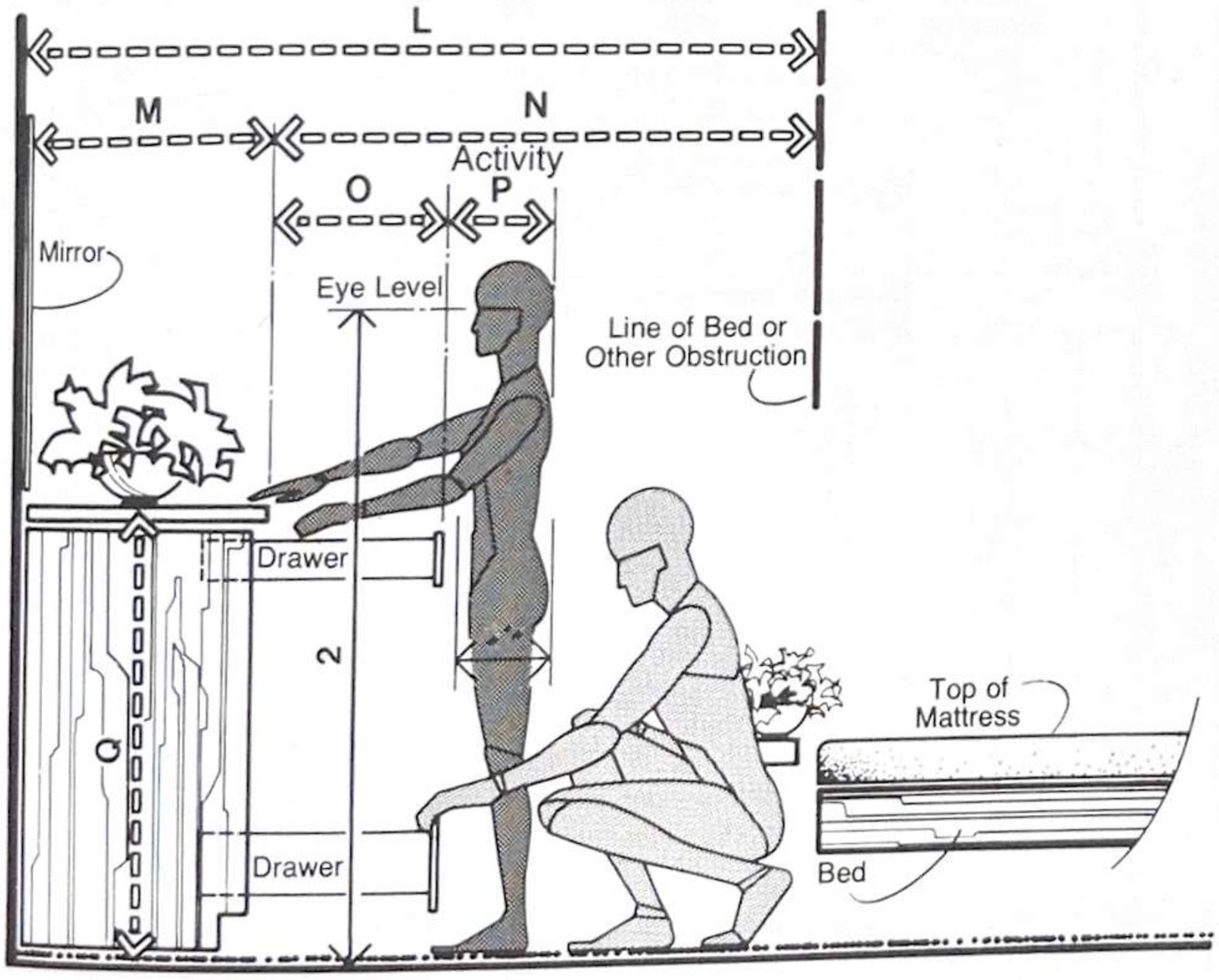
The center drawings show vertical clearances between the seat surface and the underside of the table and between the seat surface and the floor as well as the distance from the top of the desk to the floor. The clearances between the seat surface and the underside of the table should anthropometrically accommodate the thigh clearance of the person of larger body size and the seat height should accommodate the popliteal height of the larger person. The relationship of seat height to worksurface is a classic one that also applies to dining tables, conference tables, and office desks. Drawing at the bottom of the page shows the clearances required between a dresser and the bed.



MAKE-UP/DRESSING TABLE



DESK OR DRESSING TABLE

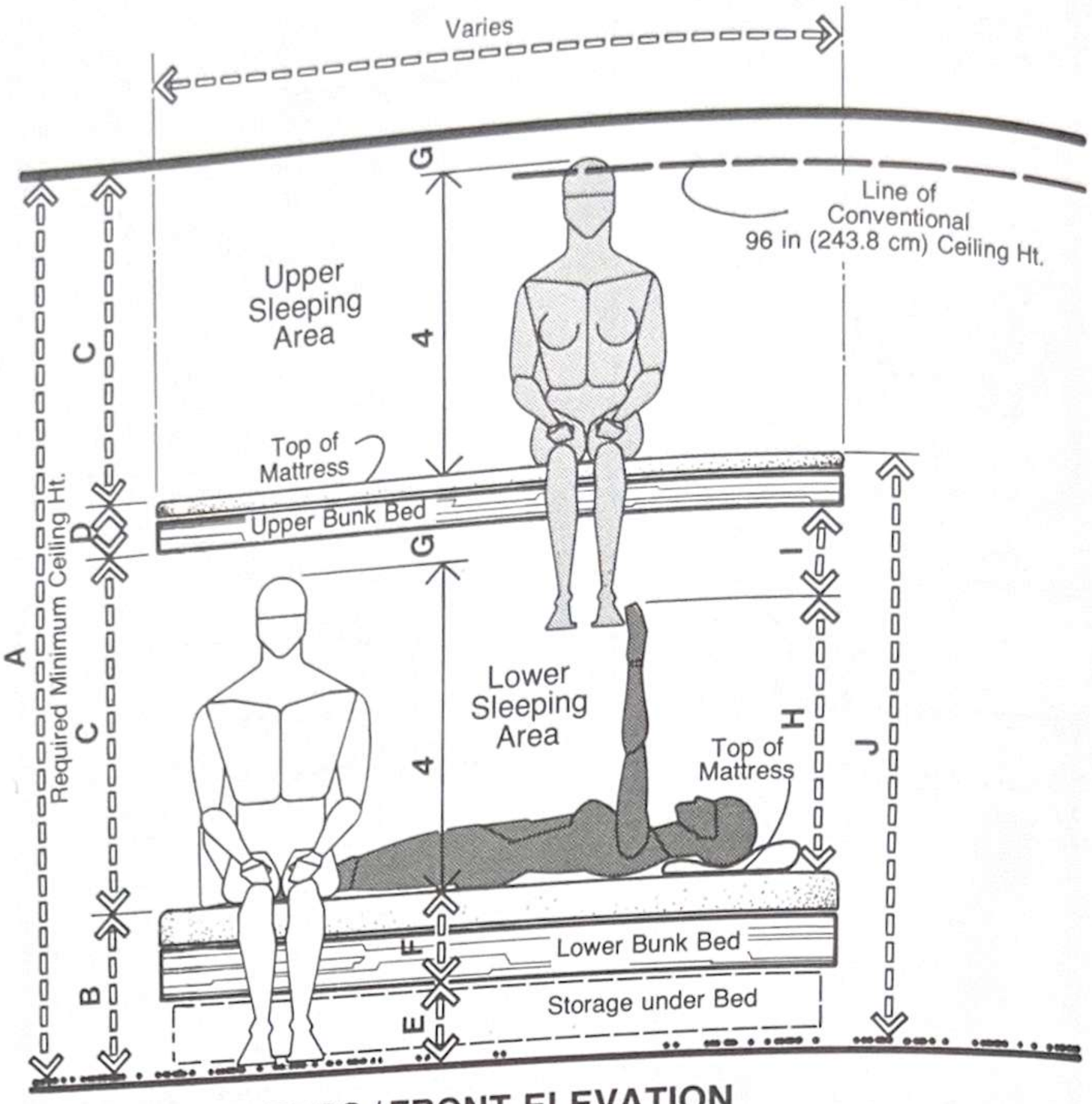


DRESSER/ BED CLEARANCES

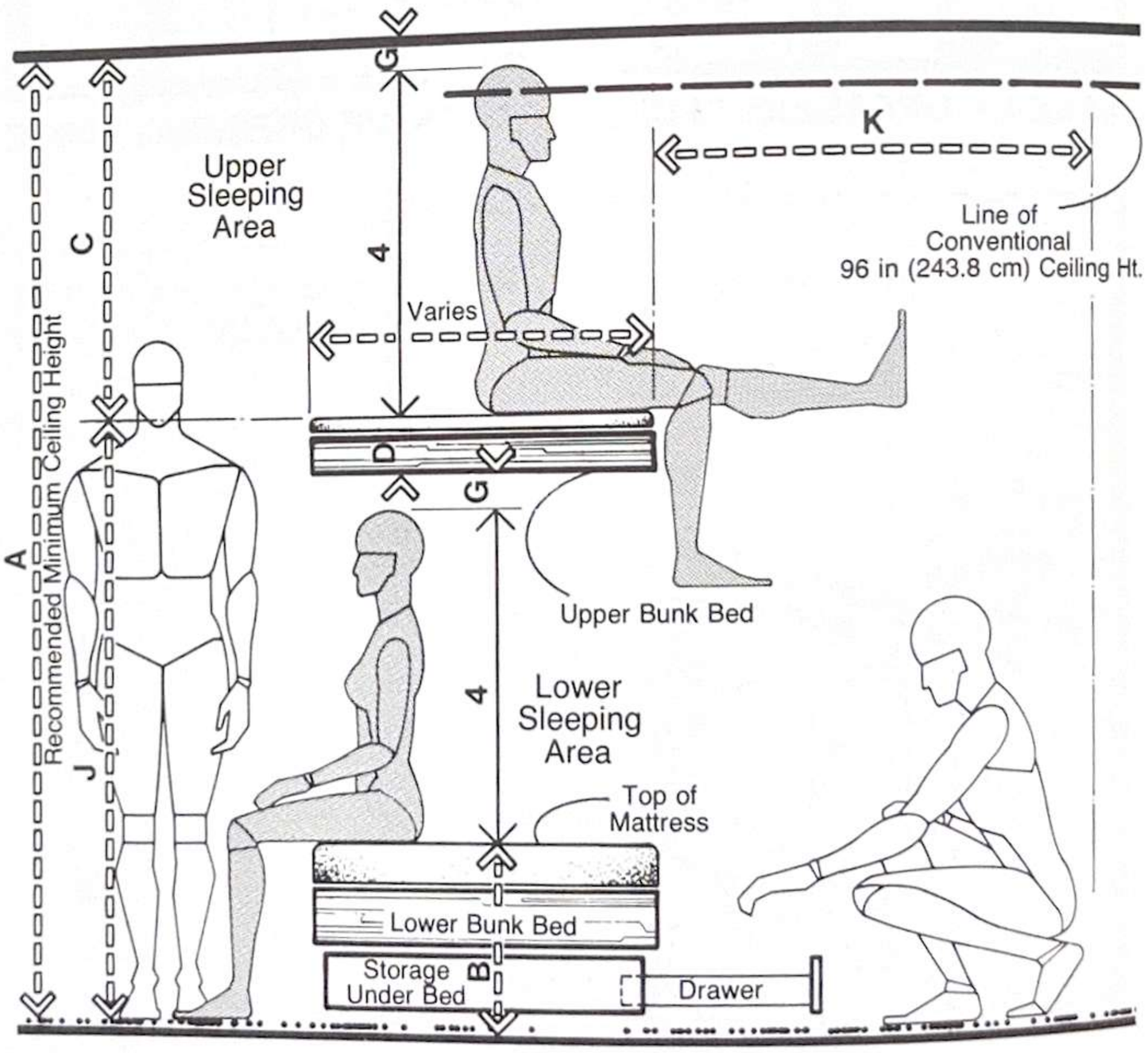
	in	cm
A	24–28	61.0–71.1
B	12–16	30.5–40.6
C	30	76.2
D	16–24	40.6–61.0
E	42–46	106.7–116.8
F	28–40	71.1–101.6
G	7 min.	17.8 min.
H	28–30	71.1–76.2
I	42–54	106.7–137.2
J	18–24	45.7–61.0
K	24–30	61.0–76.2
L	62–72	157.5–182.9
M	20–24	50.8–61.0
N	42–48	106.7–121.9
O	16–20	40.6–50.8
P	18	45.7
Q	42	106.7

2.3 SLEEPING SPACES

Overhead sleeping facilities are a common space-saving device, particularly where the number of bedrooms or bedroom size is limited. Although standard bunk beds are available on the market, it is often necessary because of user preference or existing conditions within the interior space to custom design the bed installation. The drawing at the top of the page shows the vertical clearances necessary to accommodate an adult of large body size. The most essential body measurement anthropometrically is sitting height. If vertical space is extremely critical, it would be wise to measure the actual sitting height of the intended user in the hope that a few inches might be saved. It should be noted that 95 percent of men between the ages of 18 and 79 have a sitting height of 38.9 in, or 98.8 cm, or less. The clearance allowed between the top of the mattress and the nearest overhead obstruction is 40 in, or 101.6 cm. Theoretically, if 6 in, or 15.2 cm, is allowed for the depth of the upper bunk and 18 in, or 45.7 cm, is allowed from the floor to the top of the lower bunk, an adult of larger body size could not be accommodated within a conventional 96-in, or 243.8-cm, ceiling height unless the depth of the lower bunk is reduced. The bottom drawing shows that a horizontal clearance of 46 to 52 in, or 116.8 to 157.5 cm, is necessary for comfortable access to the underbed storage.

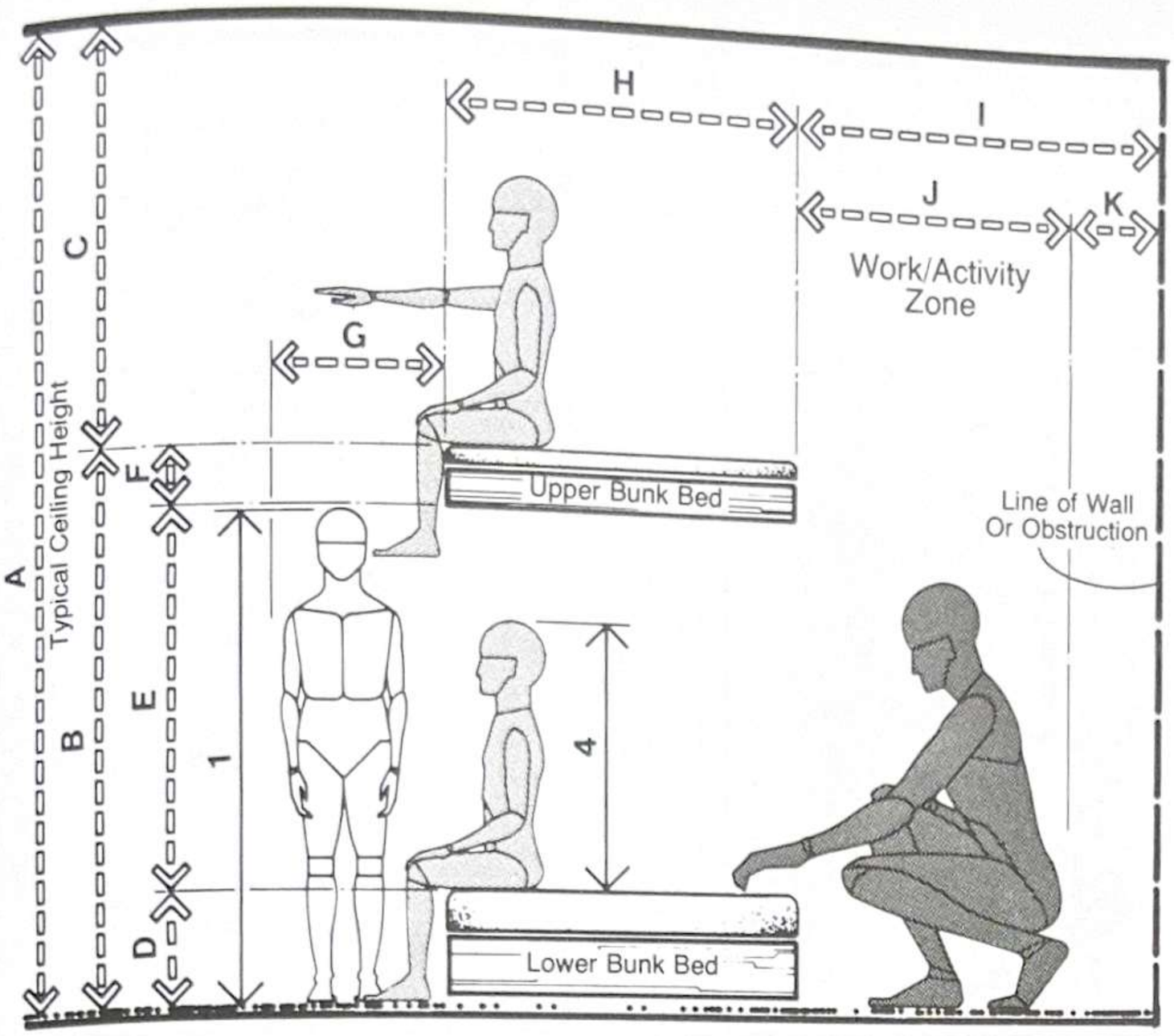


ADULT BUNK BEDS / FRONT ELEVATION

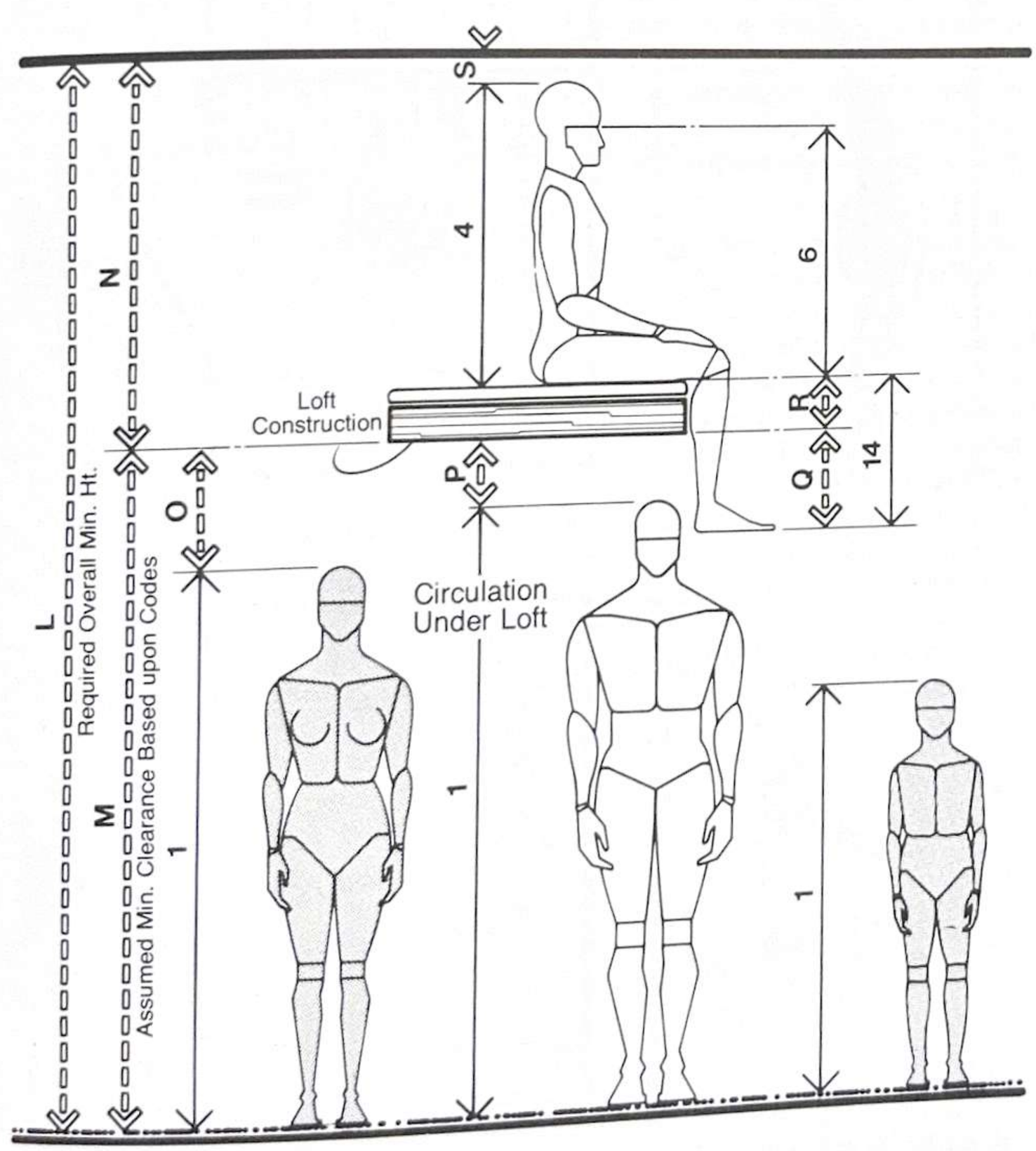


ADULT BUNK BEDS / END ELEVATION

	in	cm
A	104	264.2
B	18–22	45.7–55.9
C	40–44	101.6–111.8
D	6–8	15.2–20.3
E	8–10	20.3–25.4
F	10–12	25.4–30.5
G	2	5.1
H	28–38	71.1–96.5
I	6–12	15.2–30.5
J	64–74	162.6–188.0
K	46–62	116.8–157.5



CHILDREN'S BUNK BEDS / END ELEVATION



SLEEPING LOFTS / END ELEVATION

2.3 SLEEPING SPACES

The drawing at the top of the page shows the vertical clearances necessary to accommodate children. The critical anthropometric consideration is the sitting height. The drawing shows clearly that a conventional ceiling height of 96 in, or 243.8 cm, will be adequate to accommodate the body size of a seated child on both the lower and upper bunk. The height of the upper bunk should be established as minimally required to accommodate the sitting height of the child so that the ladder climb will not be greater than necessary. The drawing at the bottom of the page illustrates the vertical clearances necessary for a loft bed. To ensure that a person can circulate under the bed without hitting his head, the critical anthropometric dimension is the stature of the person of larger body size. Popliteal height and buttock-toe length are also useful in approximating the degree of intrusion of the leg and the foot of the seated person into the circulation space below.

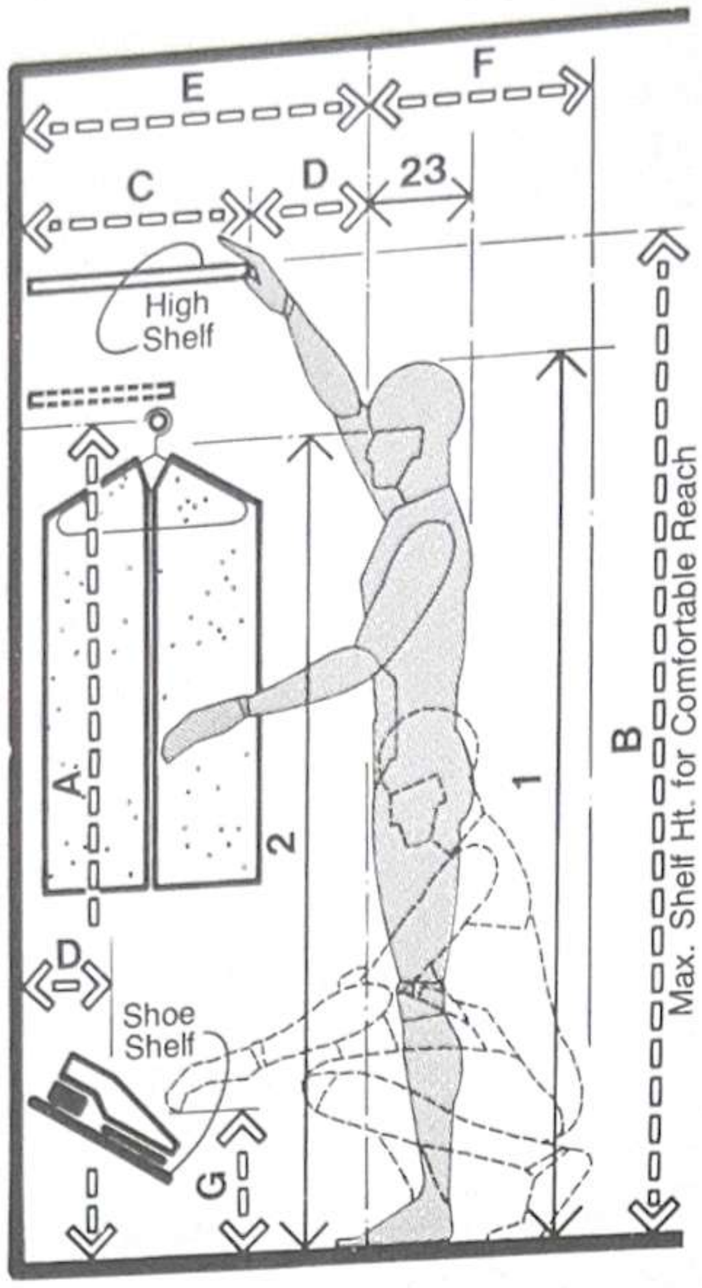
It should be noted that in design situations where space below the bed is used for a function other than circulation, such as dining or a desk-related activity, the vertical clearances can be reduced accordingly.

	in	cm
A	96	243.8
B	54.5–62	138.4–157.5
C	36.5–39	92.7–99.1
D	12–15	30.5–38.1
E	36.5–39	92.7–99.1
F	6–8	15.2–20.3
G	14–18	35.6–45.7
H	30–39	76.2–99.1
I	37–39	94.0–99.1
J	34–36	86.4–91.4
K	3	7.6
L	130–136	330.2–345.4
M	84	213.4
N	46–52	116.8–132.1
O	17	43.2
P	11	27.9
Q	5–14	12.7–35.6
R	6–8	15.2–20.3
S	2	5.1

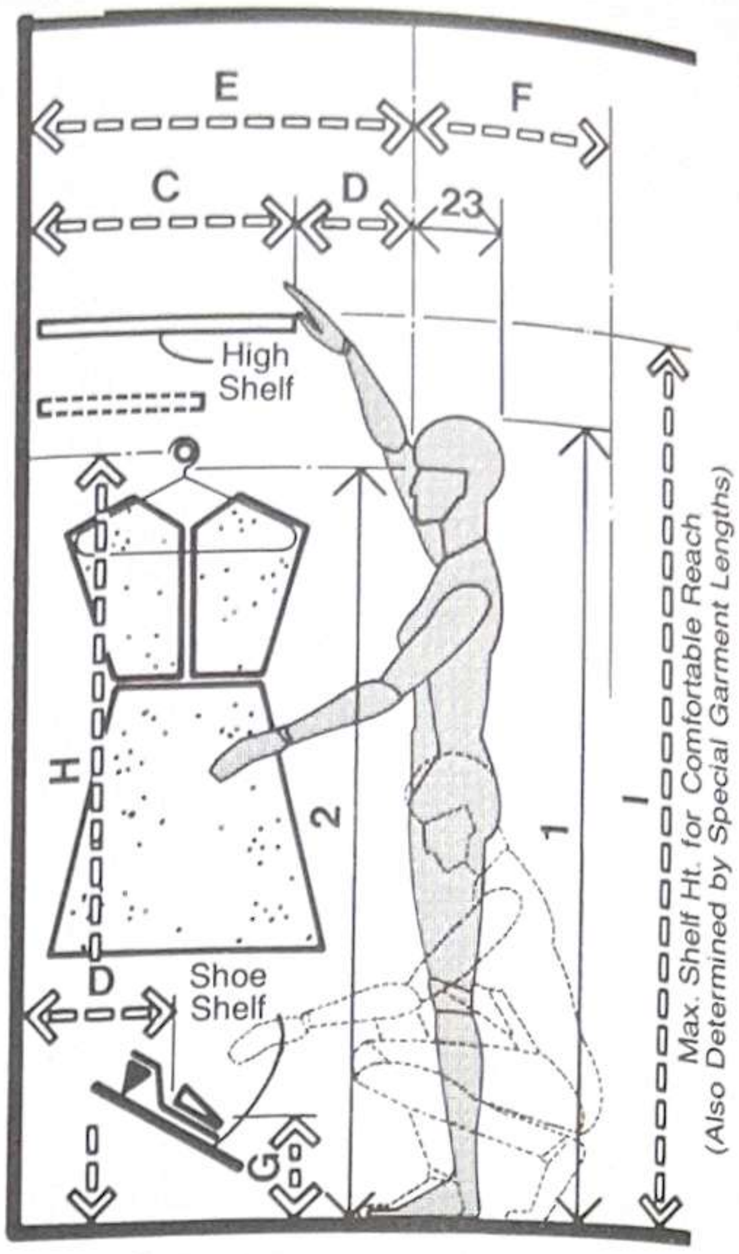
2.3 SLEEPING SPACES

The two drawings at the top of the page show the vertical clearances related to male and female closet and storage facilities. Wherever possible or practical, the closet shelf should be located within human reach. The height shown for the high shelf has been established based on 5th percentile male and female data in order to place it within reach of individuals of smaller body size. Any shelf located at a greater distance above the floor should be used primarily for storage that requires only infrequent access. The location of the shelf just above the rod is essentially a function of rod height. The clearance between the bottom of the shelf and the top of the rod should allow for easy removal of the hanger.

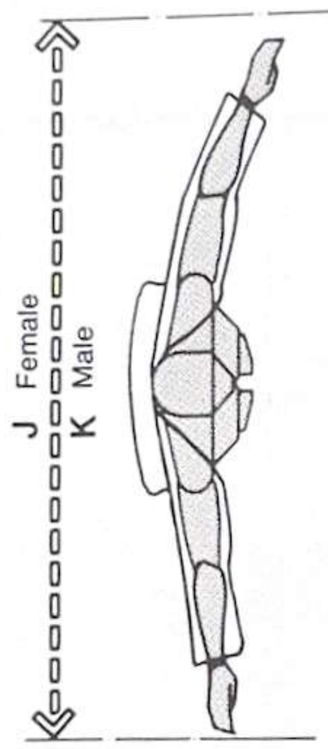
The bottom drawings illustrate two various types of walk-in storage facilities. Undoubtably, it can be argued that the 36-in, or 91.4-cm, clearance shown between the hanging garment and the storage shelf or between opposite garments could be reduced about 50 percent. The authors contend, however, that in order to achieve any degree of comfort in the selection and removal of the desired garment, a minimum of 36 in should be maintained. The degree to which this dimension can be reduced is a question of the level of comfort the user is prepared to tolerate in exchange for the floor space saved. The two drawings of the plan view of the human figure illustrate clearances required for donning a coat or putting on a pair of stockings.

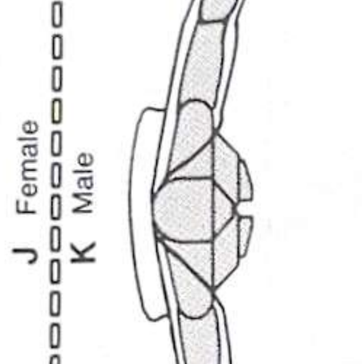


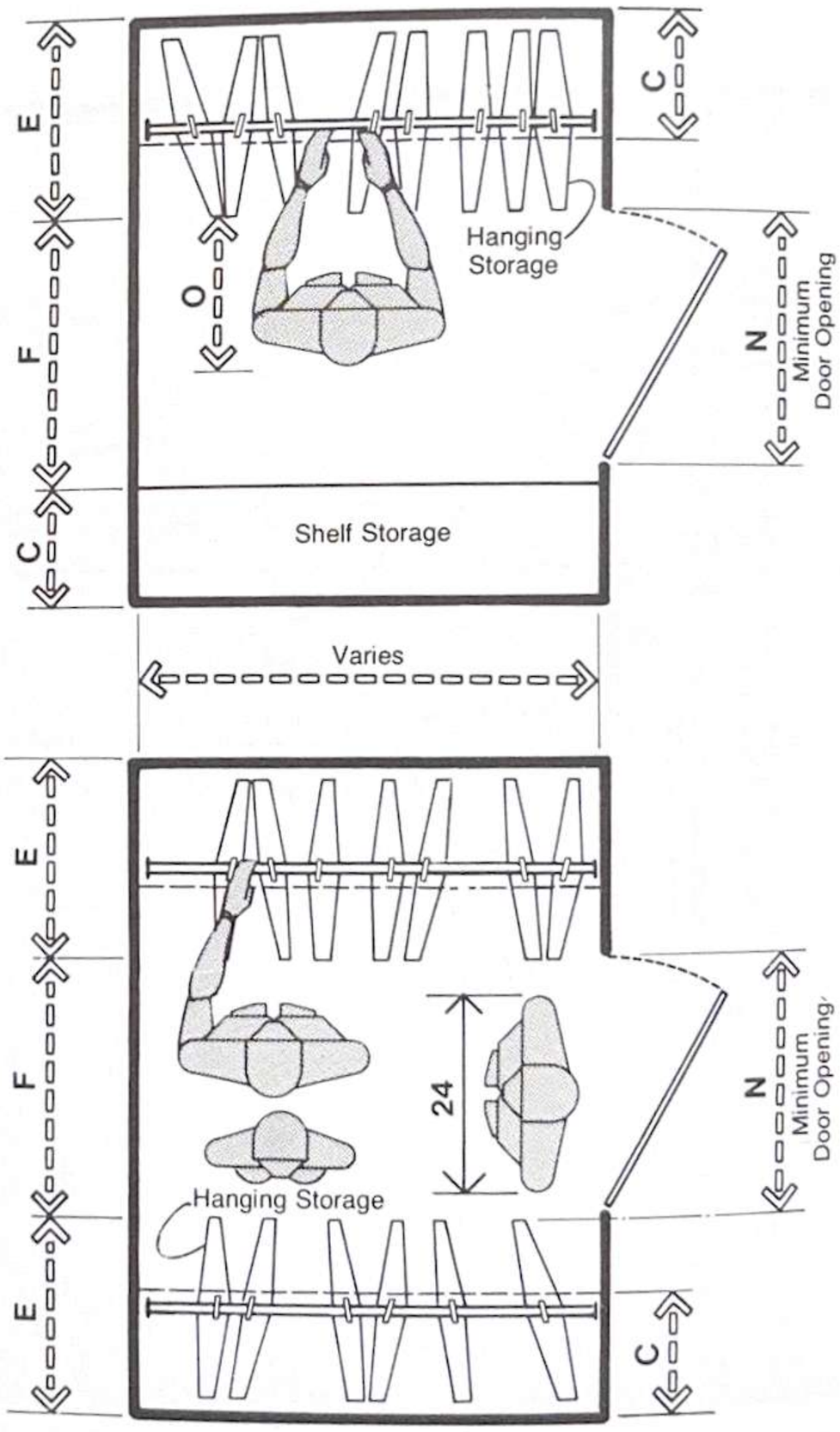
CLOSET AND STORAGE FACILITIES / MALE



CLOSET AND STORAGE FACILITIES / FEMALE







WALK-IN CLOSET AND STORAGE FACILITIES

	in	cm
A	64–68	162.6–172.7
B	72–76	182.9–193.0
C	12–18	30.5–45.7
D	8–10	20.3–25.4
E	20–28	50.8–71.1
F	34–36	86.4–91.4
G	10–12	25.4–30.5
H	60–70	152.4–177.8
I	69–72	175.3–182.9
J	76	193.0
K	68	172.7
L	42	106.7
M	46	116.8
N	30	76.2
O	18	45.7

2.4 COOKING SPACES

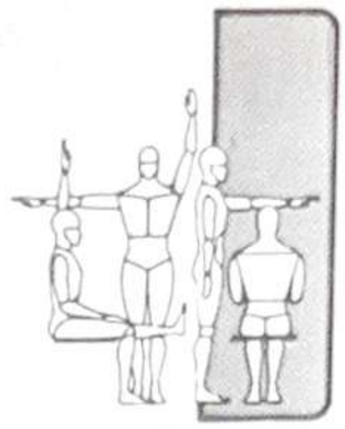


TABLE	STORAGE	PREPARATION	DINING	SINK	REFRIGERATOR	RANGE/OVEN
1A,2B	●			●		
1B,3C	○			◒	◒	●
1C,3B		◒		◒		
1D,2C			●			
1F,3G			●			
1L,2H		●	●			
1P,2L		●	●			
1T,4F	○					
1V,4D				○		
1W,6B	●	●		●		●
1X,6A	●	●	●	●		●

ACTIVITIES	ANTHROPOMETRIC DATA
	1 STATURE
	2 EYE HEIGHT
	3 ELBOW HEIGHT
	4 SITTING HEIGHT ERECT
	6 EYE HEIGHT SITTING
	12 THIGH CLEARANCE
	16 BUTTOCK-KNEE LENGTH
	20 VERTICAL GRIP REACH
	22 THUMB TIP REACH
	23 MAXIMUM BODY DEPTH
	24 MAXIMUM BODY BREADTH

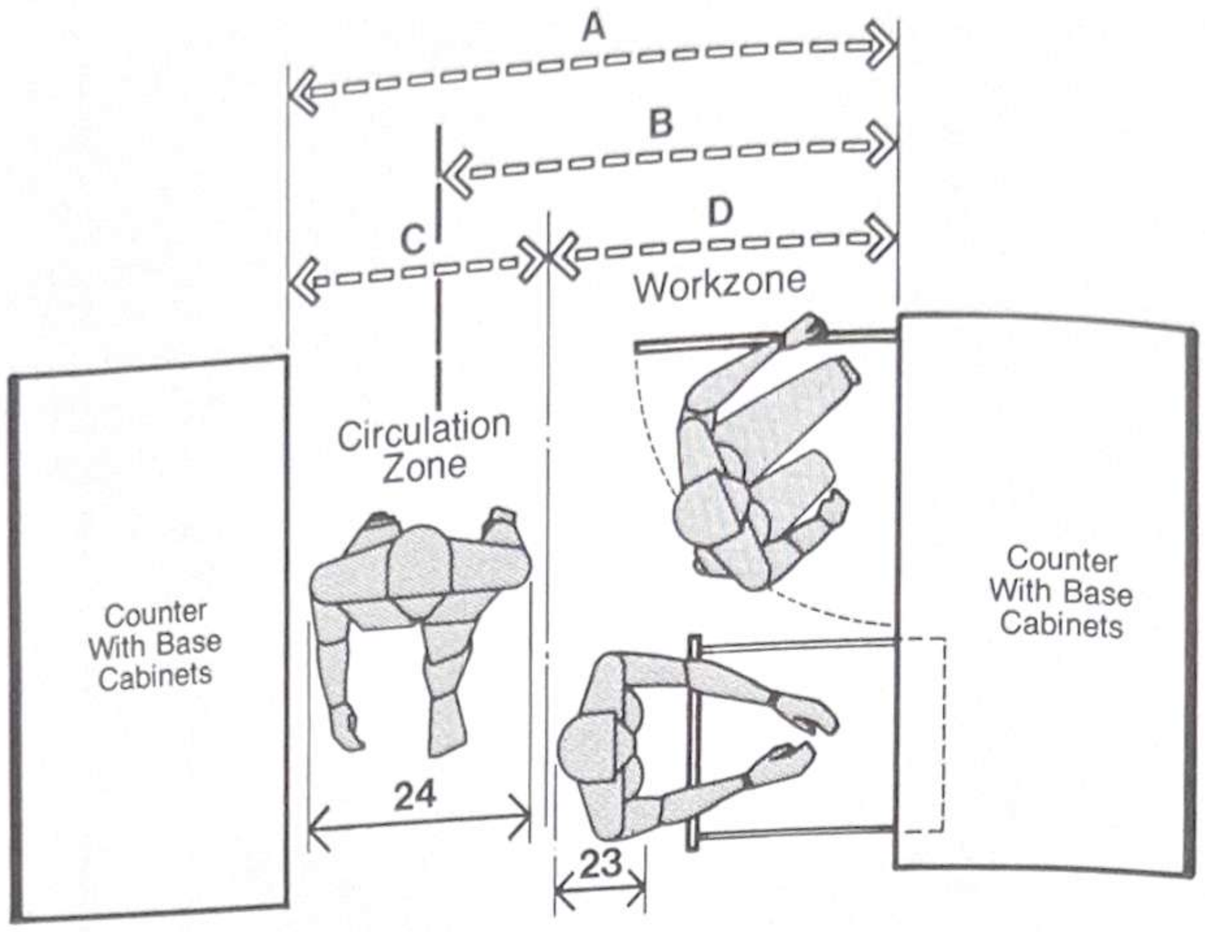
The height of a kitchen workcounter, the proper clearance between cabinets or appliances for circulation, the accessibility to overhead or undercounter storage, and proper visibility are among the primary considerations in the design of cooking spaces. All must be responsive to human dimension and body size if the quality of interface between the user and the components of the interior space are to be adequate. In establishing clearances between counters, the maximum body breadth and depth of the user of larger body size must be taken into account as well as the projections of the appliances. Refrigerator doors, cabinet drawers, dishwashing machine doors, and cabinet doors all project to some degree in their open position into the space within which the user must circulate and must be accommodated.

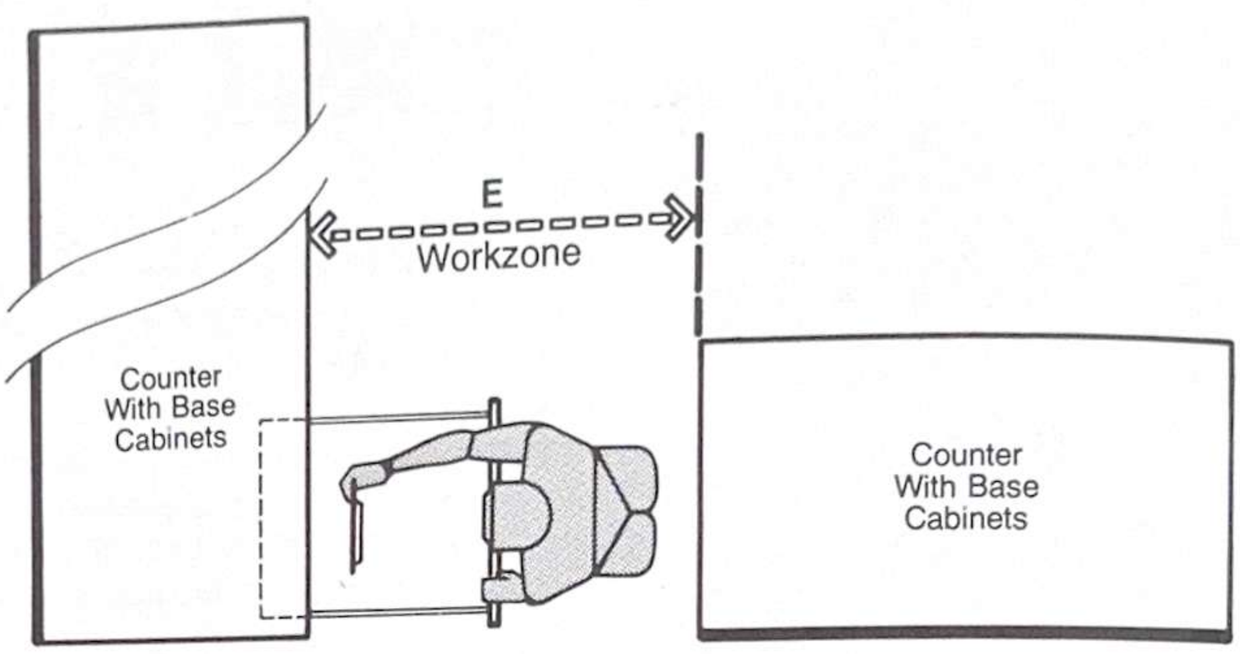
Standard kitchen counter heights manufactured are all about 36 in, or 91.4 cm. But such a height does not necessarily accommodate the body dimension of all users for all tasks. Certain cooking activities, for example, may be more efficiently performed from a standing position, but with a counter height less than 36 in. In overhead cabinets the upper shelves are usually inaccessible to the smaller person, while the lower shelves are usually inaccessible to most without bending or kneeling. The logical answer is the development of kitchen cabinet systems capable of total adjustability to accommodate the human dimension of the individual user. Such a system could accommodate not only those of smaller and larger body size, but also elderly and disabled people. The drawings on the following pages examine the question of human dimension in terms of the anthropometric measurements indicated in the above matrix. It should be noted, however, that the drawings are intended merely to illustrate the relationship of body size to clearances and reach situations and not to suggest an overall functional plan for the kitchen or the ergonomic relationship between workcenters.

2.4 COOKING SPACES

The drawings at the top and center of the page illustrate some of the basic horizontal clearances required in a kitchen. The drawing at the top shows clearances between two counters with base cabinets. A total clearance between cabinets of 60 to 66 in, or 152.4 to 167 cm, will accommodate the human body and an extended drawer or hinged cabinet door in the workzone and in the circulation zone the maximum body breadth of a person of larger body size. The B dimension of 48 in, or 121.9 cm, is a recommended minimum clearance between cabinets when the full circulation zone shown is not desired. The center drawing also shows a recommended clearance of 48 in between the face of a cabinet and the nearest physical obstruction.

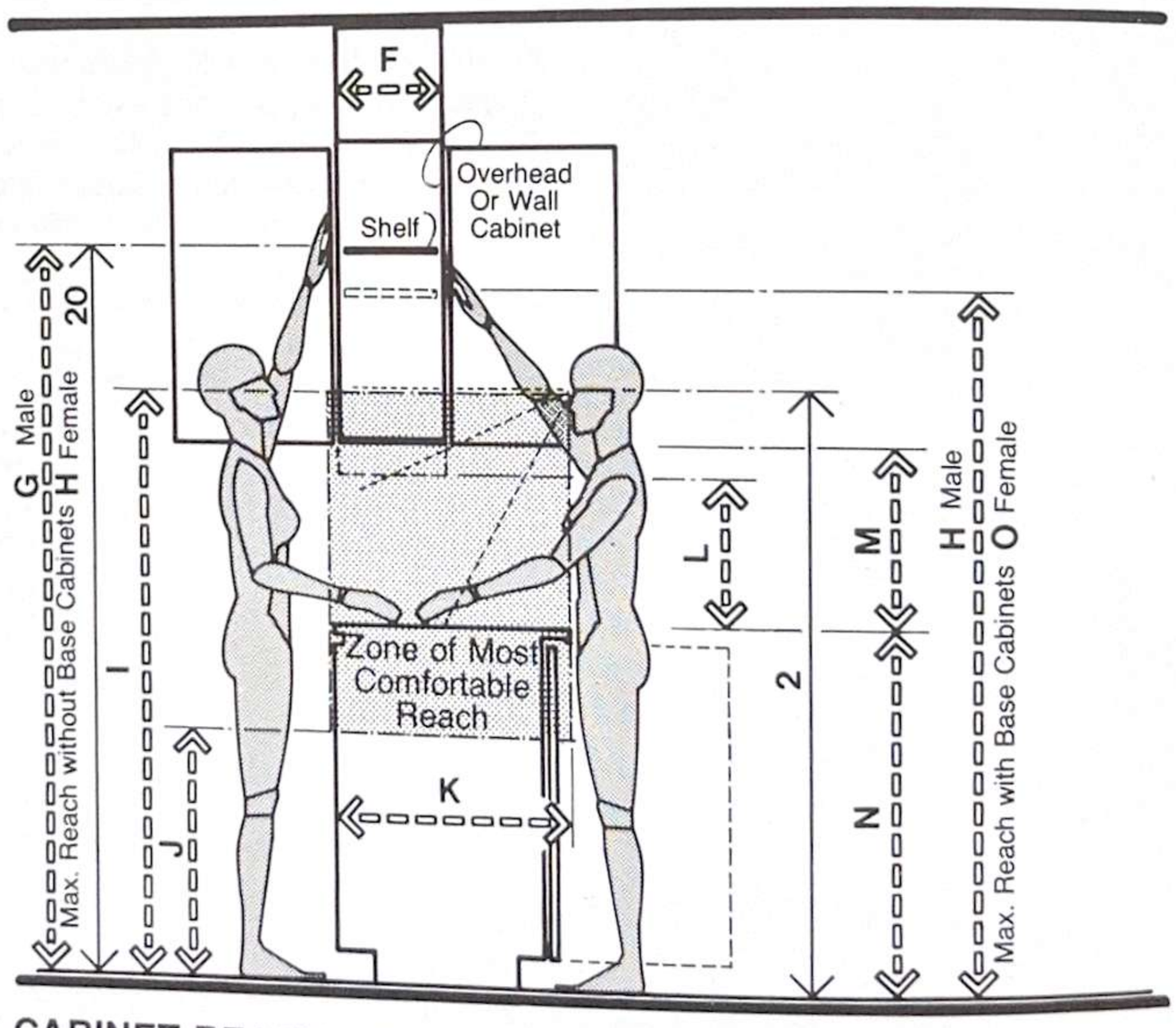
The drawing at the bottom of the page deals with vertical clearances. The height of the shelf, shown in broken lines, within the overhead cabinets is within reach, allowing for the projection of the base cabinet. The height of the shelf, shown as a solid black line, is slightly greater, but also within reach, since the base cabinet does not interfere. The height of the shelves has been based on 5th percentile female vertical grip reach data to place them within reach of the user with the smaller body size.



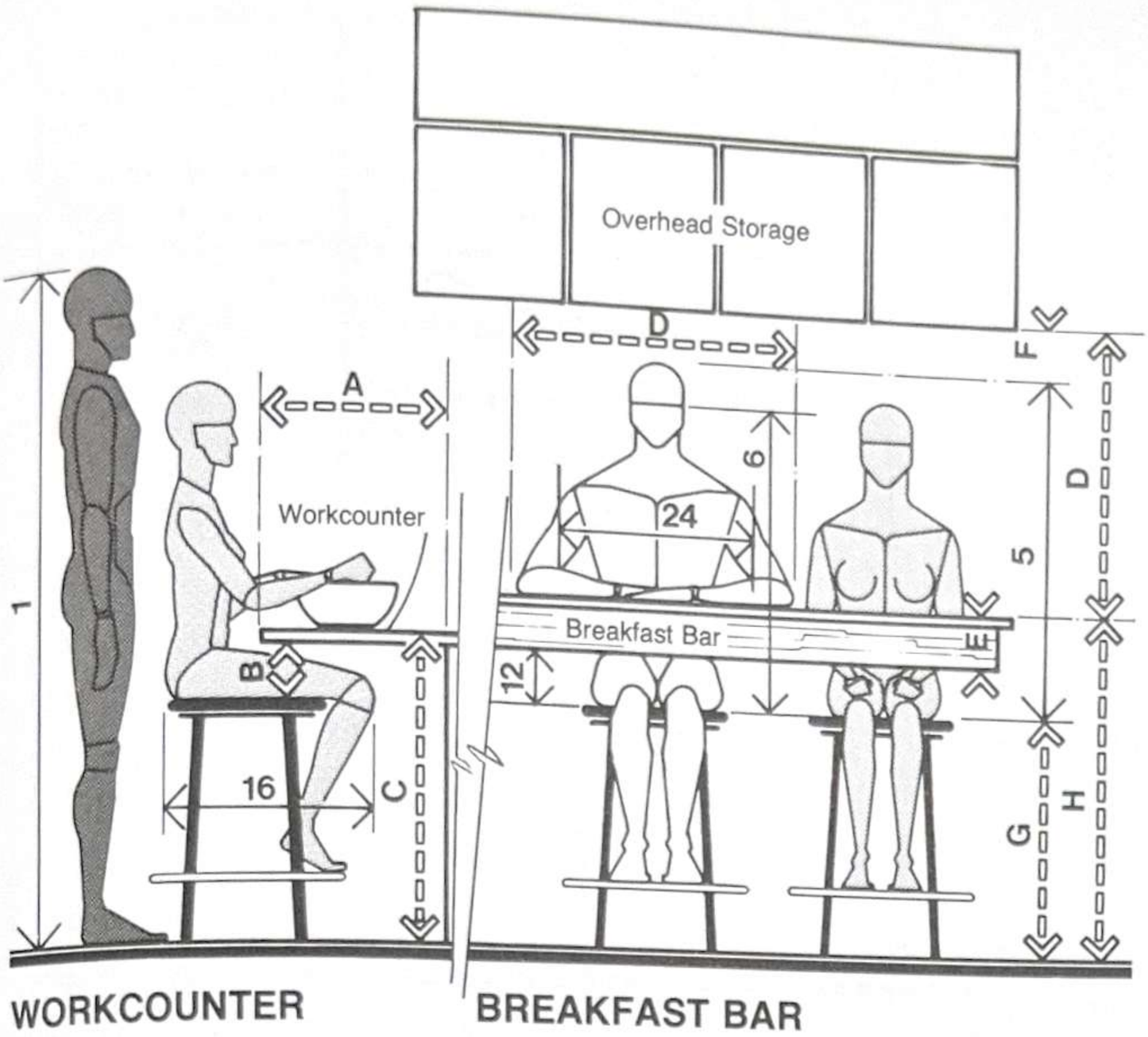


COUNTER AND BASE CABINETS/ GENERAL CLEARANCE

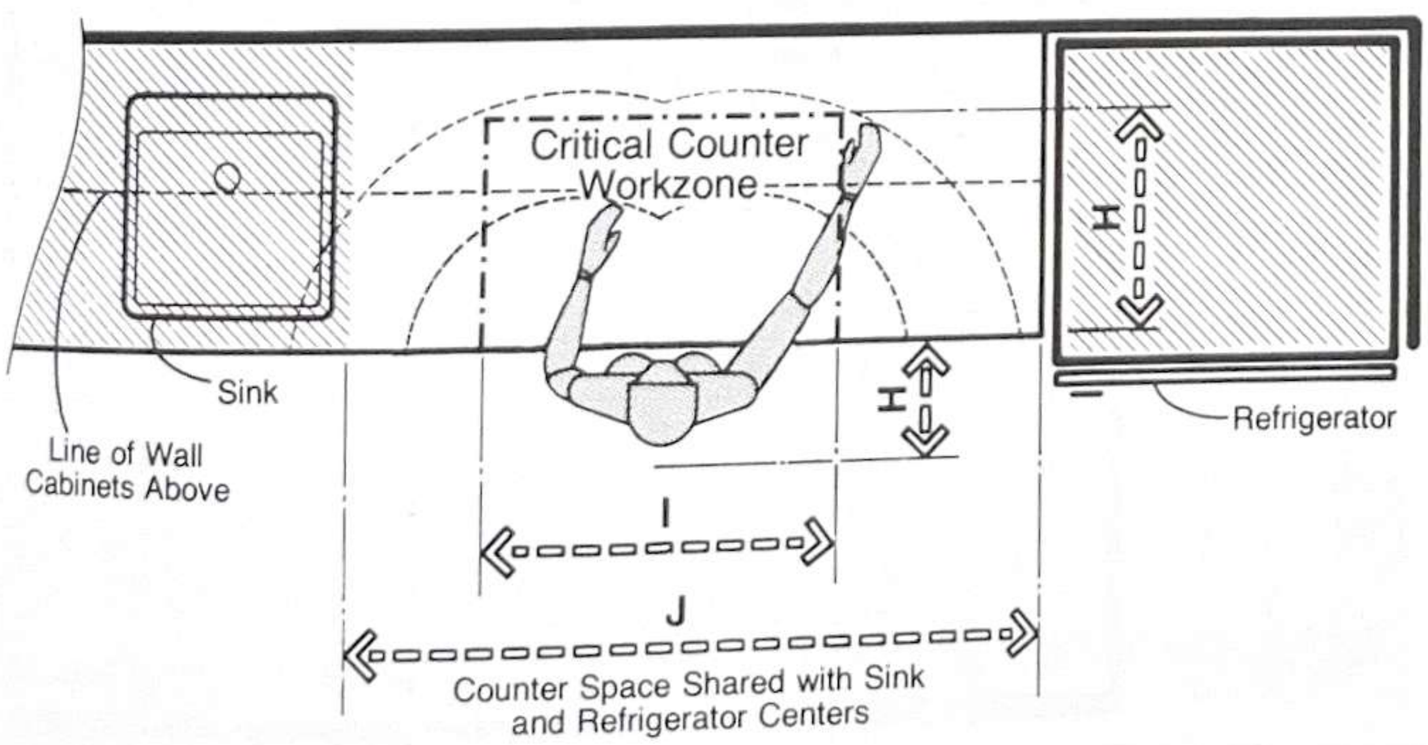
	in	cm
A	60–66	152.4–167.6
B	48 min.	121.9 min.
C	24–30	61.0–76.2
D	36	91.4
E	48	121.9
F	12–13	30.5–33.0
G	76 max.	193.0 max.
H	72 max.	182.9 max.
I	59	149.9
J	25.5	64.8
K	24–26	61.0–66.0
L	15 min.	38.1 min.
M	18	45.7
N	35–36	88.9–91.4
O	69 max.	175.3 max.



CABINET REACH COMPARISONS



WORKCOUNTER BREAKFAST BAR



MIX AND PREPARATION CENTER

2.4 COOKING SPACES

The drawing at the top of the page shows some of the more important horizontal and vertical clearances related to a typical breakfast bar. To ensure comfortable spacing between people, 30 in, or 76.2 cm, should be allocated for the horizontal space required for each person seated at the bar. It should be noted also that a bar height of 36 in, or 91.4 cm, requires that the stool be equipped with a footrest.

The center drawing shows a typical workcounter. Although most kitchen counters have a height of 35 to 36 in, or 88.9 to 91.4 cm, a 32-in, or 81.3-cm, height will accommodate a seated user. Moreover, certain food preparation activities, even if performed from a standing position, are more efficiently and comfortably executed with a lower counter height. This is particularly true for tasks involving some degree of force from the arms and upper back muscles; the rolling of dough would be a good example.

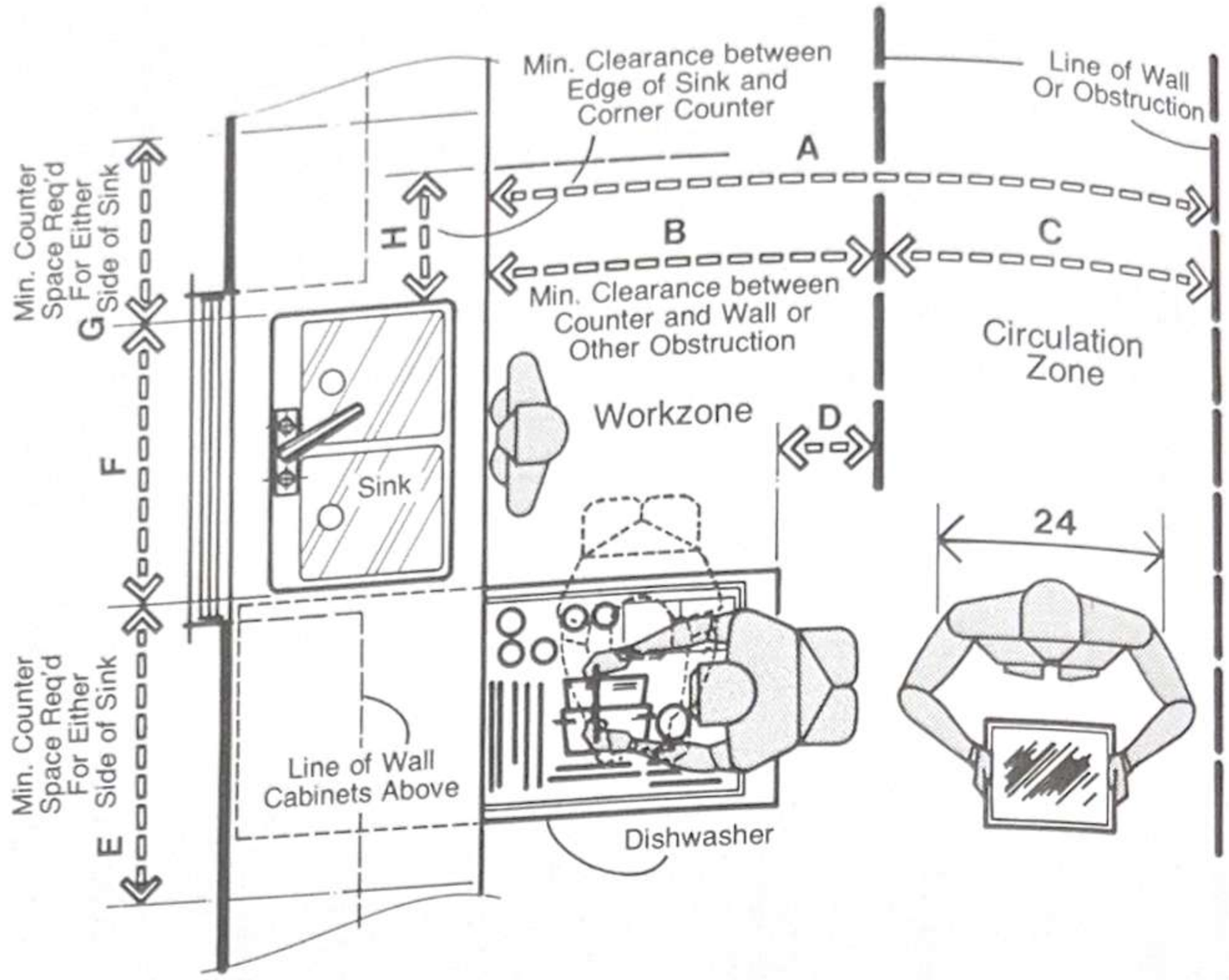
The drawing at the bottom of the page shows the critical counter workzone of a standing user. The outer perimeter is defined by the horizontal thumb tip reach of the user having the smaller body size. The 18-in, or 45.7-cm, dimension indicated was adapted from 5th percentile female data. The critical counter workzone of 18 by 30 in, or 45.7 by 76.2 cm, constitutes the immediate work area directly in front of the user, all of which is comfortably accessible, with little or no side arm reach required. The counter surface beyond this area, which is accessible with some effort, is limited only by the reach capability of the human body, which varies with the size of the individual.

	in	cm
A	18 min.	45.7 min.
B	7.5 min.	19.1 min.
C	32	81.3
D	30	76.2
E	4 max.	10.2 max.
F	4	10.2
G	22–24.5	55.9–62.2
H	18	45.7
I	36	91.4
J	42	106.7

2.4 COOKING SPACES

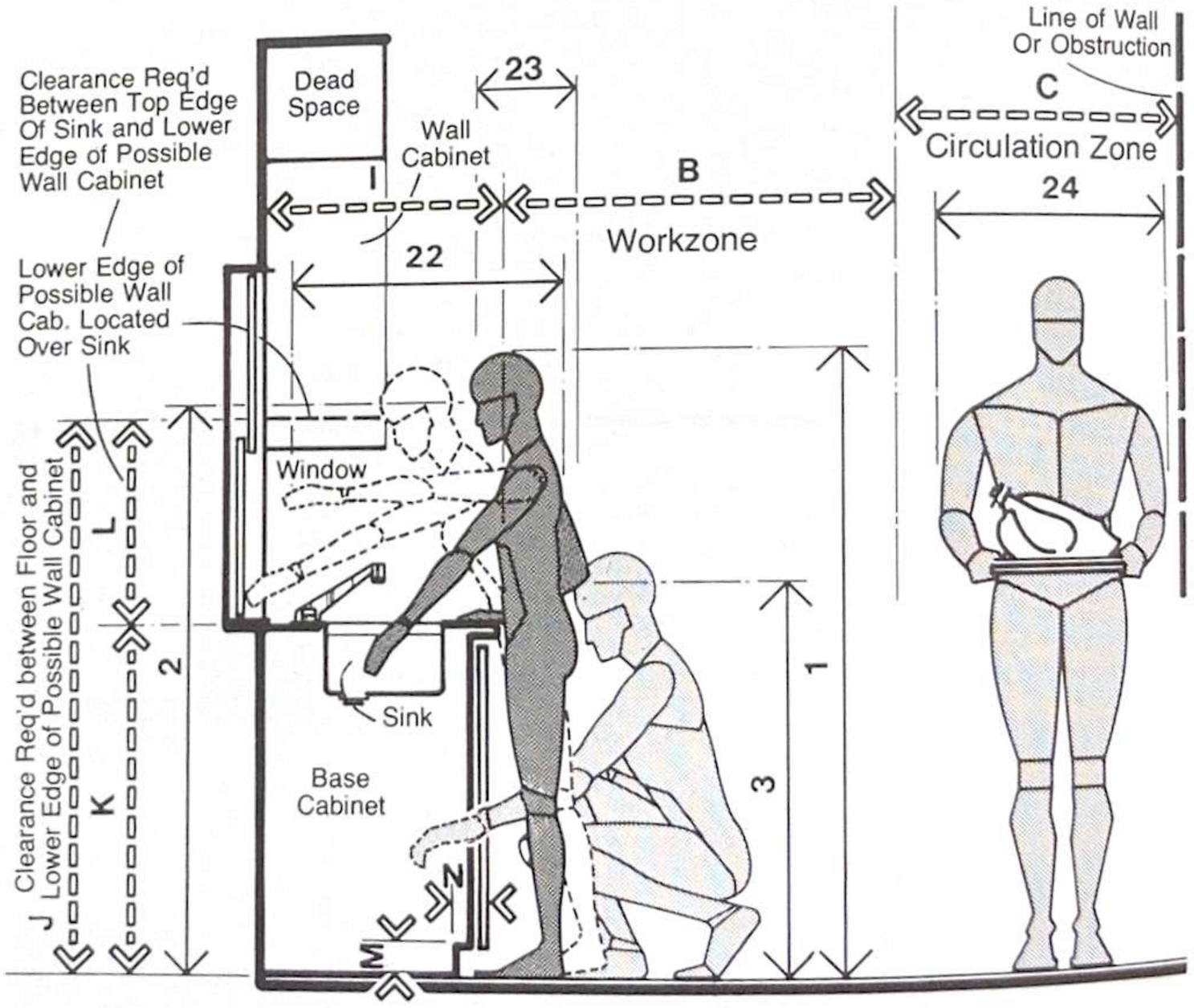
The drawing at the top of the page shows the horizontal clearances involved in the vicinity of the dish washing area. While loading or unloading the dishwasher, a clearance of at least 40 in, or 101.6 cm, is recommended to accommodate the human body and the extended dish rack and appliance door. To allow circulation as well, at least another 30 in, or 76.2 cm, should be added.

The drawing at the bottom of the page shows a sectional view through the same area. The recommended counter height is between 35 and 36 in, or 88.9 to 91.4 cm. If no window is provided over the kitchen sink and wall cabinets are to be provided instead, the height between the top of the counter and the bottom of those cabinets should not be less than 22 in, or 55.9 cm.

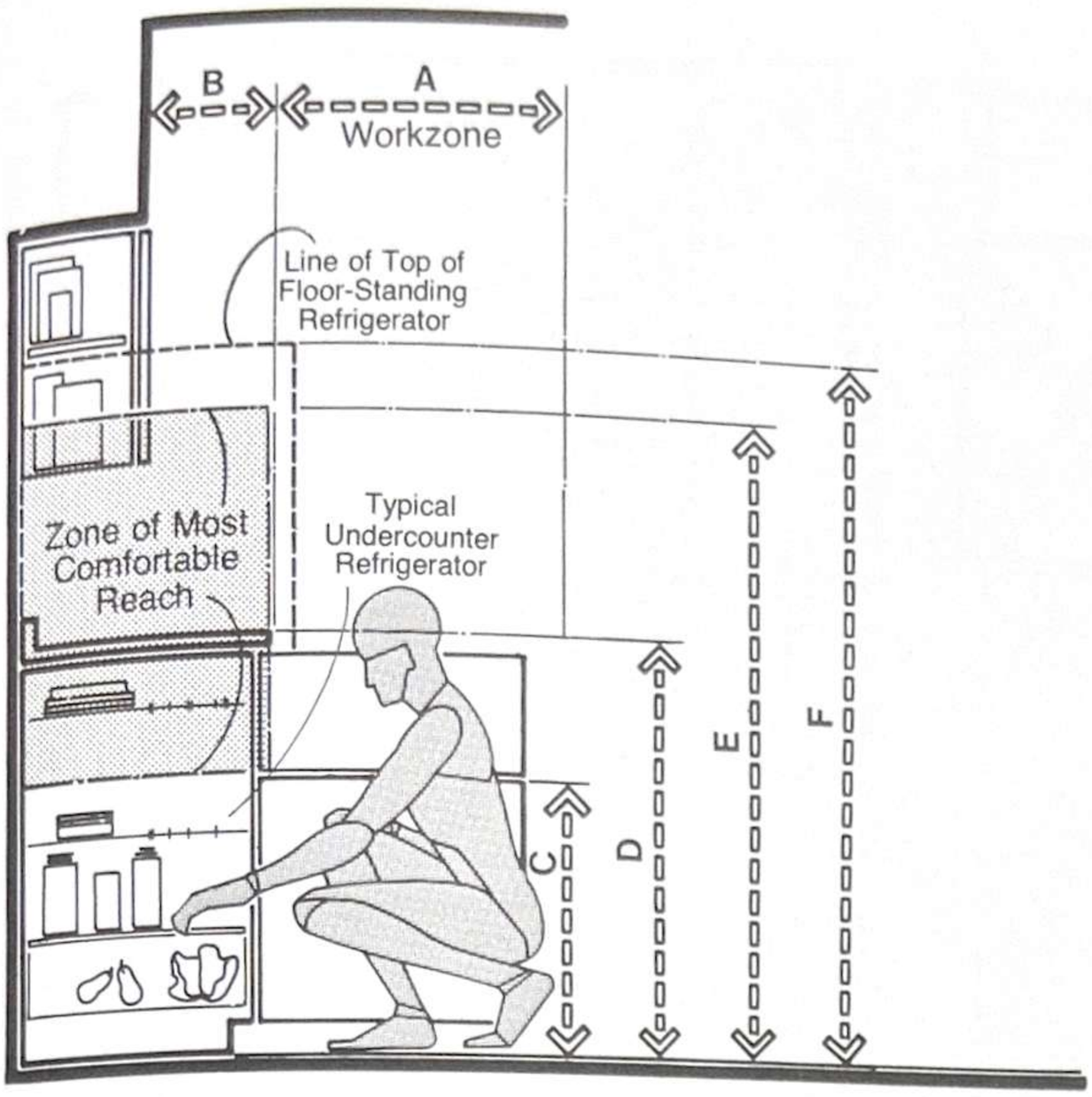


SINK CENTER

	in	cm
A	70–76	177.8–193.0
B	40 min.	101.6 min.
C	30–36	76.2–91.4
D	18	45.7
E	24 min.	61.0 min.
F	28–42	71.1–106.7
G	18 min.	45.7 min.
H	12 min.	30.5 min.
I	24–26	61.0–66.0
J	57 min.	144.8 min.
K	35–36	88.9–91.4
L	22 min.	55.9 min.
M	3	7.6
N	4	10.2



SINK CENTER



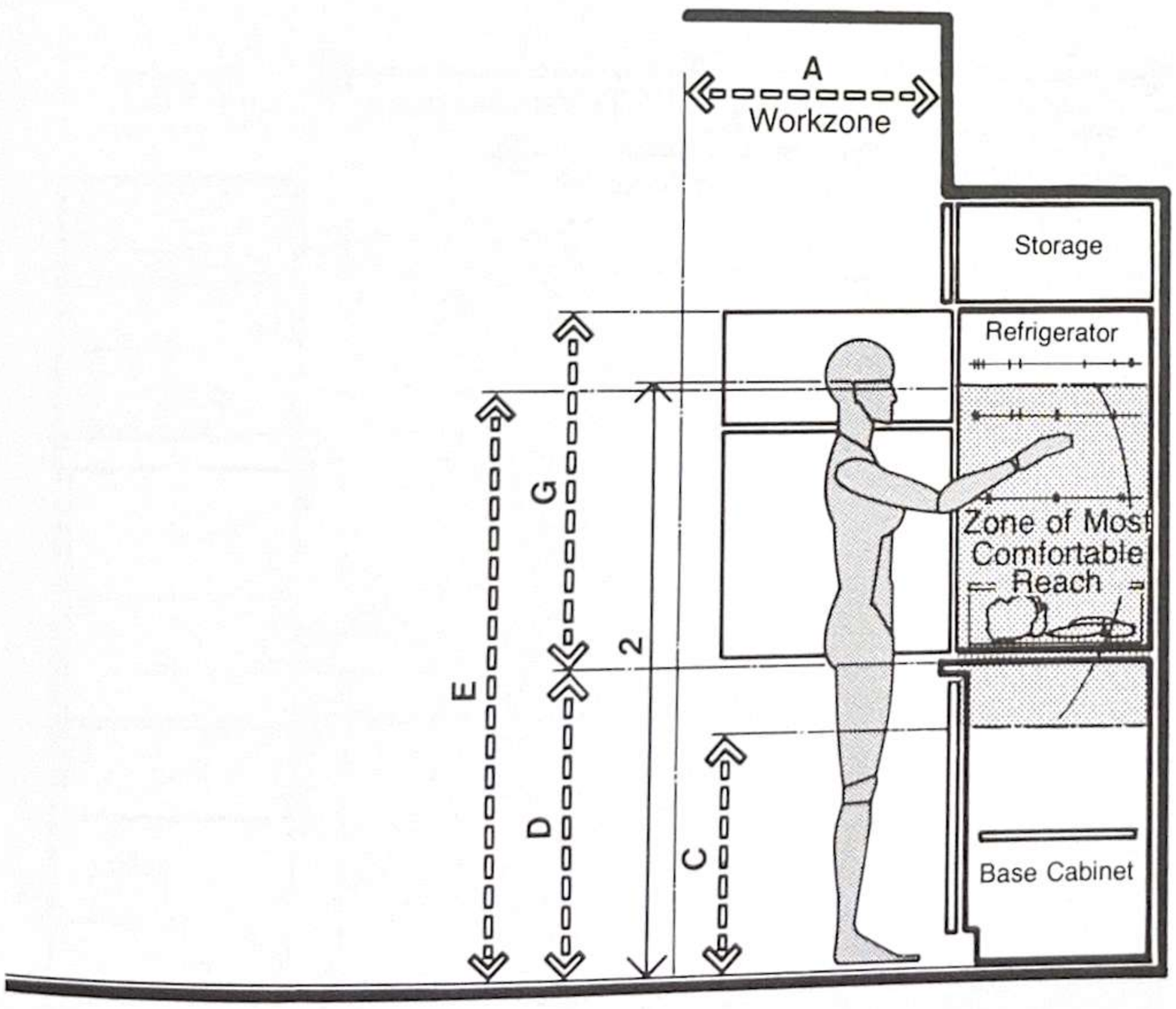
**REFRIGERATOR CENTER/
TYPICAL REFRIGERATOR LOCATIONS**

2.4 COOKING SPACES

The two drawings on this page deal primarily with the vertical dimensions related to the refrigerator installation within the kitchen.

The top drawing illustrates a typical floor-standing refrigerator installation as well as a below-counter installation. Superimposed on the sectional view in shaded film is the zone of most comfortable reach. To reach elements located above or below this area requires some additional effort. Below the area, for example, it may be necessary to kneel or stoop. Although, in both the floor-standing and the undercounter situations everything is within physical reach, elements located within the shaded area can be reached almost effortlessly.

The bottom drawing suggests the possibility of a third type of refrigerator that might be wall mounted or located on the top of the counter, so that most of its surface would fall within this shaded area. To allow for proper viewing of the interior, the height of the proposed unit exceeds the upper limits of the shaded zone. Despite its slightly greater height, the unit is just about in line with the height above the floor of the larger-size conventional floor-standing model.



**REFRIGERATOR CENTER/
PROPOSED REFRIGERATOR LOCATION**

	in	cm
A	36	91.4
B	11–14	27.9–35.6
C	25.5	64.8
D	35–36	88.9–91.4
E	59	149.9
F	55–69.5	139.7–176.5
G	30–36	76.2–91.4

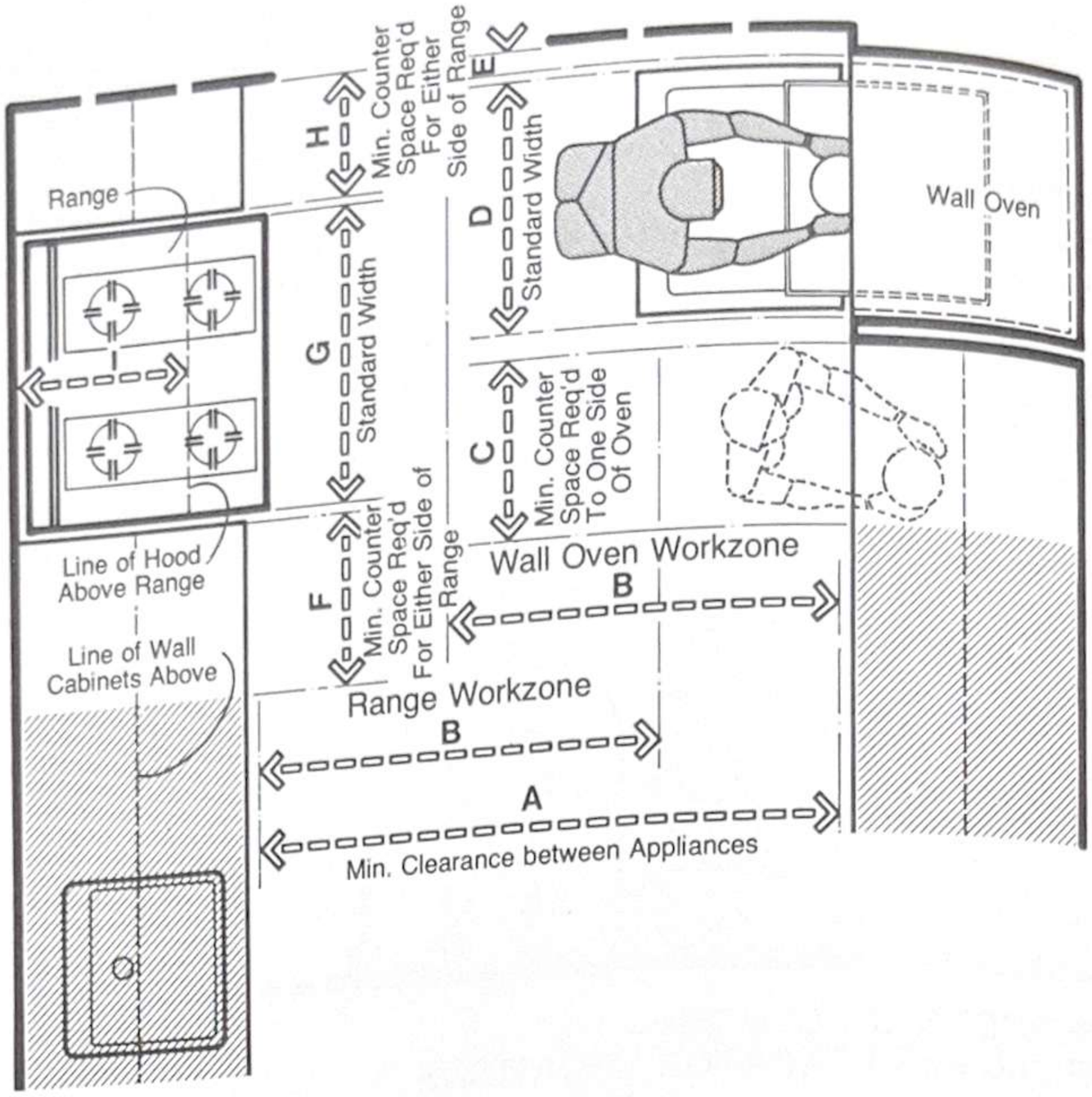
Printed in China

2.4 COOKING SPACES

The drawings at the top and bottom of the page illustrate the clearances related to range centers. The top drawing indicates a minimum clearance between appliances of 48 in, 121.9 cm. The anthropometric basis for the clearances are amplified in the drawing below.

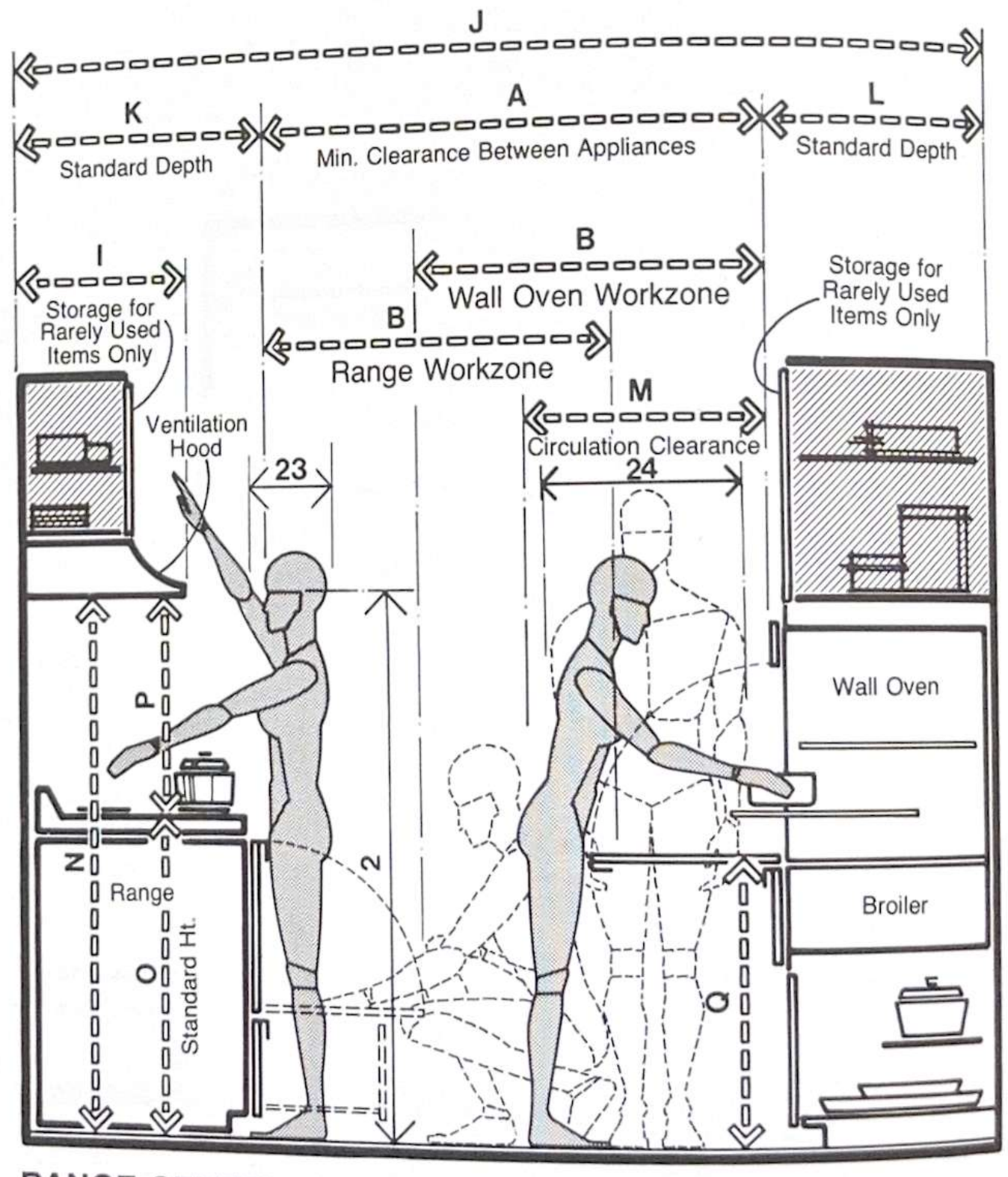
The 40-in, or 101.6 cm, wall oven workzone clearance is adequate to accommodate the projected wall oven door, in addition to the maximum body depth dimension of the user. The standing figure shown in broken line, however, indicates both dimensionally and graphically that the 40-in clearance will not permit comfortable circulation when appliances on both sides are in operation at the same time. The range workzone clearance, also 40-in, is adequate to accommodate the open range door and the body size of the kneeling user.

An extremely important, but frequently overlooked, anthropometric consideration in kitchen design is eye height. In this regard, the distance from the top of the range to the underside of the hood should allow the rear burners to be visible to the user.



RANGE CENTER

	in	cm
A	48 min.	121.9 min.
B	40	101.6
C	15	38.1 min.
D	21–30	53.3–76.2
E	1–3	2.5–7.6
F	15 min.	38.1 min.
G	19.5–46	49.5–116.8
H	12 min.	30.5 min.
I	17.5 max.	44.5 max
J	96–101.5	243.8–257.8
K	24–27.5	61.0–69.9
L	24–26	61.0–66.0
M	30	76.2
N	60 min.	152.4 min.
O	35–36.25	88.9–92.1
P	24 min.	61.0 min.
Q	35 max.	88.9 max.



RANGE CENTER

2.5 BATHROOMS

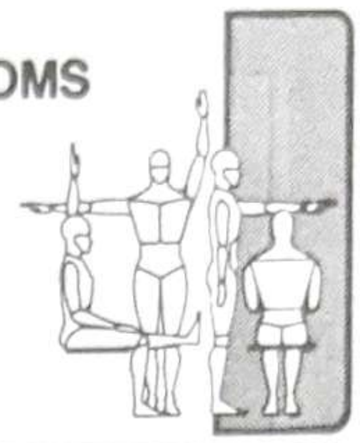


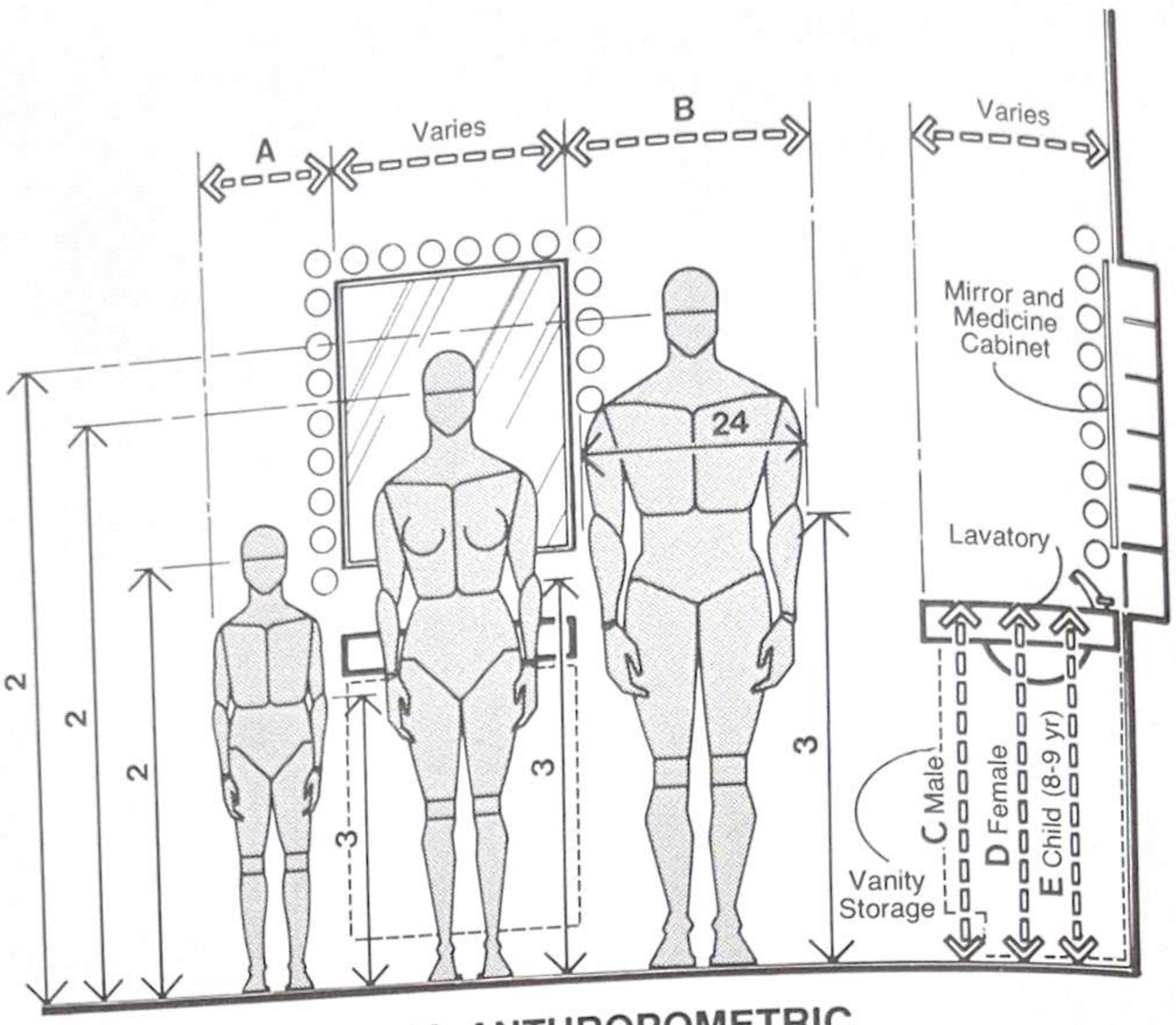
TABLE	LAVATORY	WATER CLOSET	BIDET	SHOWER	BATHTUB	CIRCULATION	ACTIVITIES / ANTHROPOMETRIC DATA
1A,2B				●			1 STATURE
1B,3C	◐						2 EYE HEIGHT
1C,3B	◐						3 ELBOW HEIGHT
1J,2F					●		10 HIP BREADTH
1P,2L		●	●				16 BUTTOCK-KNEE LENGTH
1R,4B					◐		18 BUTTOCK-HEEL LENGTH
1S,4C					○		19 VERTICAL REACH HEIGHT SITTING
1T,4F				○			20 VERTICAL GRIP REACH
1U,4E		○					21 SIDE ARM REACH
1V,4D	○	○					22 THUMB TIP REACH
1W,6B	●	●					23 MAXIMUM BODY DEPTH
1X,6A				●	●	●	24 MAXIMUM BODY BREADTH

One of the most dramatic examples of a design situation where little consideration is given to the relationship of human dimension and body size to the designed environment can be found in practically every bathroom, private and public. Few designers, builders, and users give any thought to the height above the floor of a lavatory. Hours, if not days, may be spent in the selection of the appropriate color, fixture, model, or trim. The height, however, is rarely specified and is simply left to the contractor in the field, who automatically installs it at the height that it has been installed for years simply because "that's the way it's done." The designer who does specify a height, in either a drawing or written specifications, does nothing more than use the same criteria employed in the field, but gives it more legitimacy by incorporating it into the drawing.

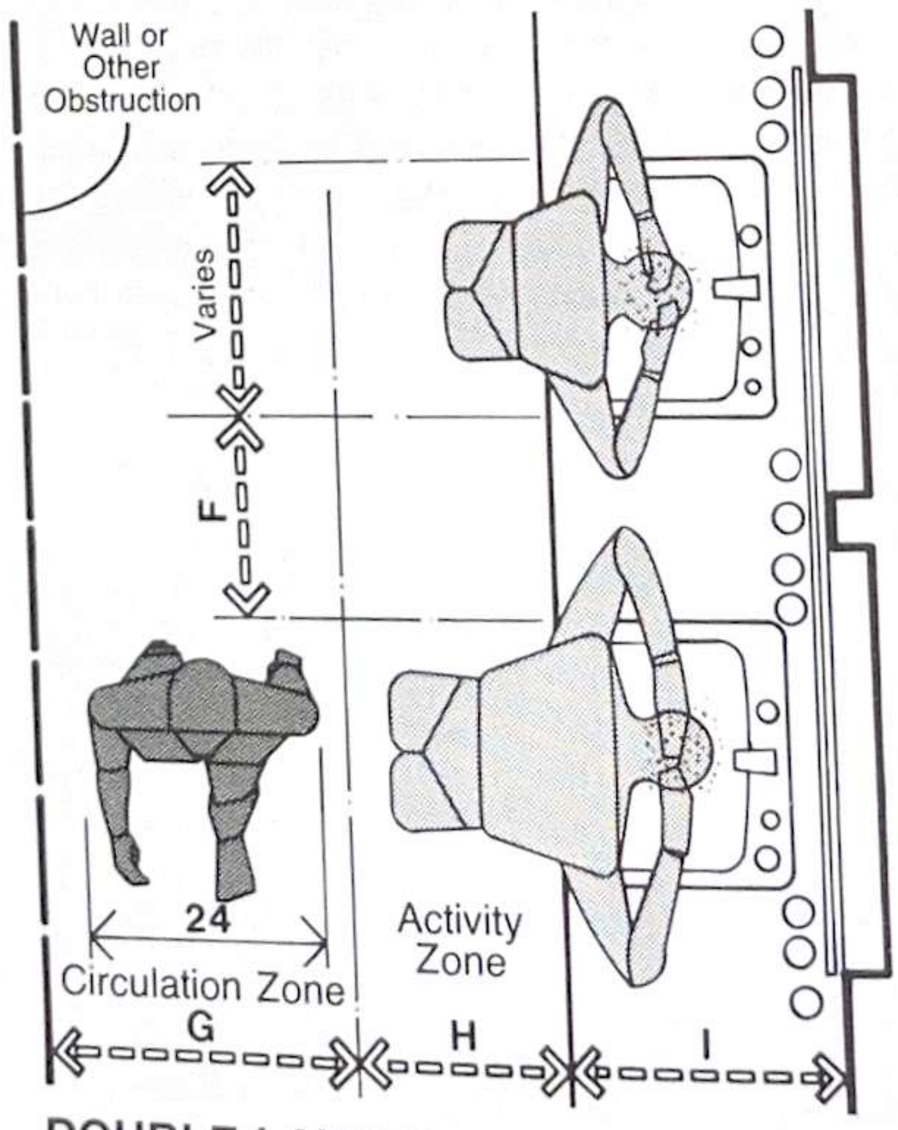
The fact is that it is not natural for the body to assume a stooped posture while washing the hands and face. This posture is necessitated, however, because most basin heights are only about 30 in, or 76.2 cm, above the floor. It is interesting to note that 30 in is also the average height of a desk or dining table, yet if a person were forced to write or eat from a standing position, each of the surfaces would have to be raised at least 6 to 12 in, or 15.2 to 30.5 cm. The drawings on the following pages examine the relationship of body size to the lavatory and other elements of bathroom spaces. The matrix above indicates some of the more important anthropometric measurements that should be considered in the design of bathrooms.

2.5 BATHROOMS

The drawing at the top of the page illustrates some of the basic anthropometric considerations related to the lavatory area. Perhaps the most obvious problem concerns the height of the lavatory above the floor. For too long this dimension has been established in the field on so-called trade practice at 31 to 34 in, or 78.7 to 86.3 cm, and has little relationship to the anthropometric requirements involved. Optimum work height for the hands on a counter or work bench situation is established at about 2 to 3 in, or 5 to 7.6 cm, below elbow height. Published data show that only 5 percent of a male sampling measured had an elbow height of 41.3 in, or 104.9 cm, or less, while 5 percent of a female sampling had an elbow height of 38.6 in, or 98 cm. Subtracting 3 in from the female measurement would place a comfortable height for the lavatory at 35.6 in, or 90.4 cm. That is greater than the height at which lavatories are normally installed, presumably to accommodate the majority of the population. Stated another way, more than 95 percent of users are not properly accommodated by the heights at which most lavatories are presently installed. The drawing indicates ranges for adult males, females, and children of lavatory heights suitable to accommodate a greater portion of the respective populations. The bottom drawing indicates horizontal clearances recommended in the lavatory area.

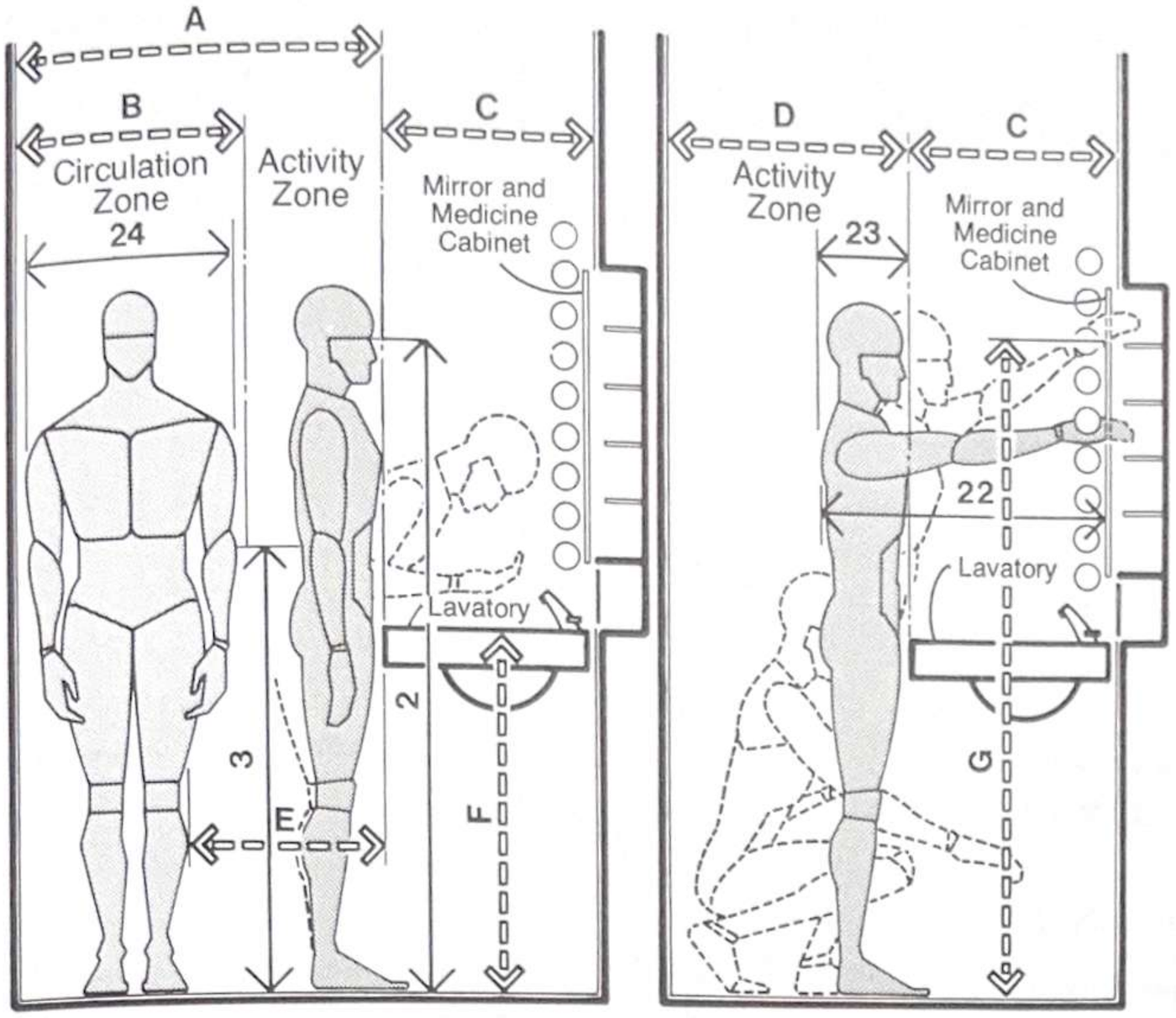


LAVATORY / GENERAL ANTHROPOMETRIC CONSIDERATIONS



DOUBLE LAVATORY CLEARANCES

	in	cm
A	15–18	38.1–45.7
B	28–30	71.1–76.2
C	37–43	94.0–109.2
D	32–36	81.3–91.4
E	26–32	66.0–81.3
F	14–16	35.6–40.6
G	30	76.2
H	18	45.7
I	21–26	53.3–66.0

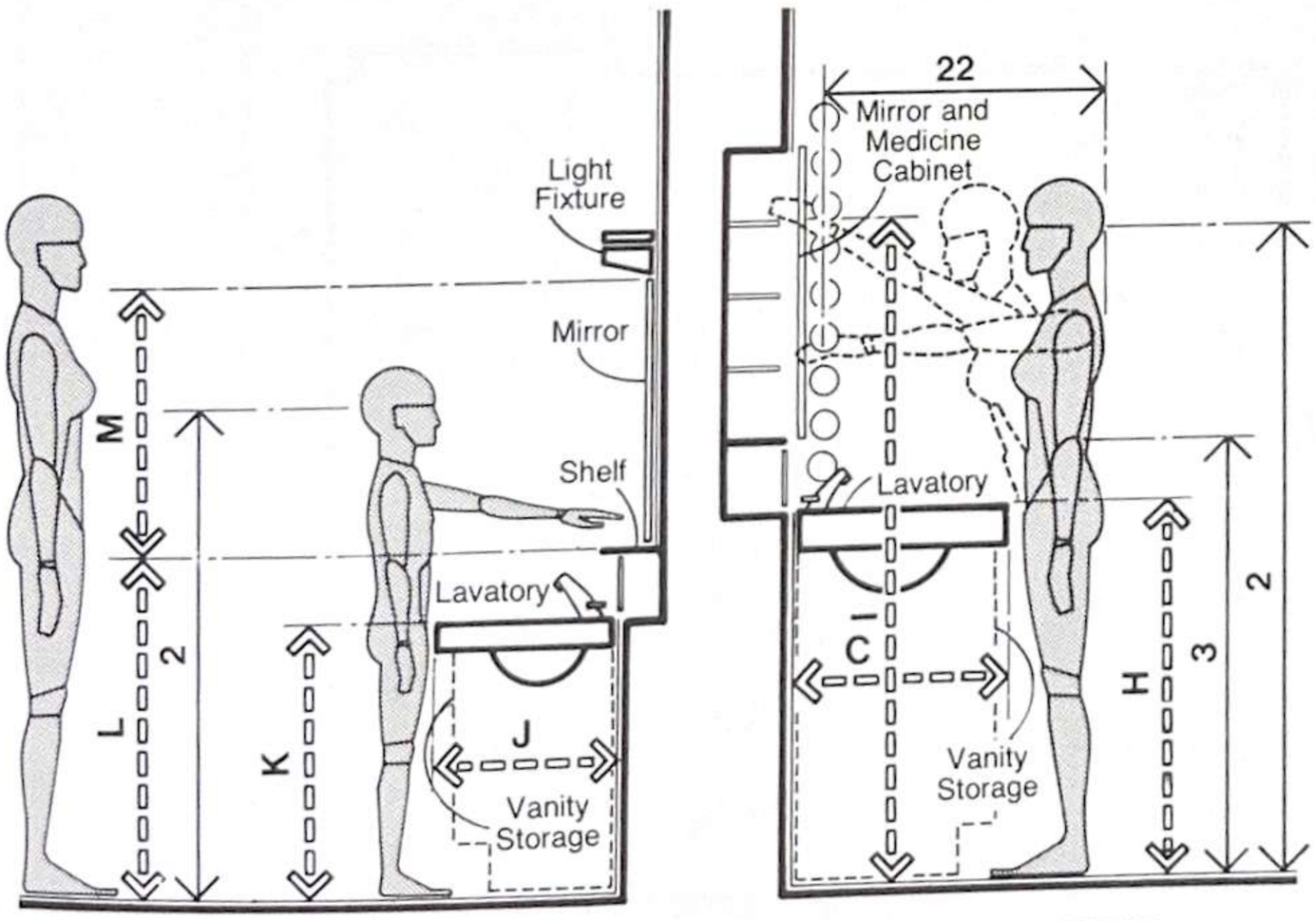


LAVATORY / MALE ANTHROPOMETRIC CONSIDERATIONS

2.5 BATHROOMS

The drawing at the top deals primarily with some of the more critical male anthropometric considerations developed on the preceding page. A lavatory height above the floor of 37 to 43 in, or 94 to 109.2 cm, is suggested to accommodate the majority of users. In order to establish the location of mirrors above the lavatory, eye height should be taken into consideration.

The two drawings at the bottom of the page explore, in much the same manner, the anthropometric considerations related to women and children, respectively. Given the great variability in body sizes to be accommodated within a single family, a strong case can be presented for the development of a height adjustment capability for the lavatory. Until that is developed, there is no reason, on custom installations, why the architect or interior designer cannot take anthropometric measurements of the client to ensure proper interface between the user and the lavatory.



LAVATORY / FEMALE AND CHILD ANTHROPOMETRIC CONSIDERATIONS

	in	cm
A	48	121.9
B	30	76.2
C	19–24	48.3–61.0
D	27 min.	68.6 min.
E	18	45.7
F	37–43	94.0–109.2
G	72 max.	182.9 max.
H	32–36	81.3–91.4
I	69 max.	175.3 max.
J	16–18	40.6–45.7
K	26–32	66.0–81.3
L	32	81.3
M	20–24	50.8–61.0

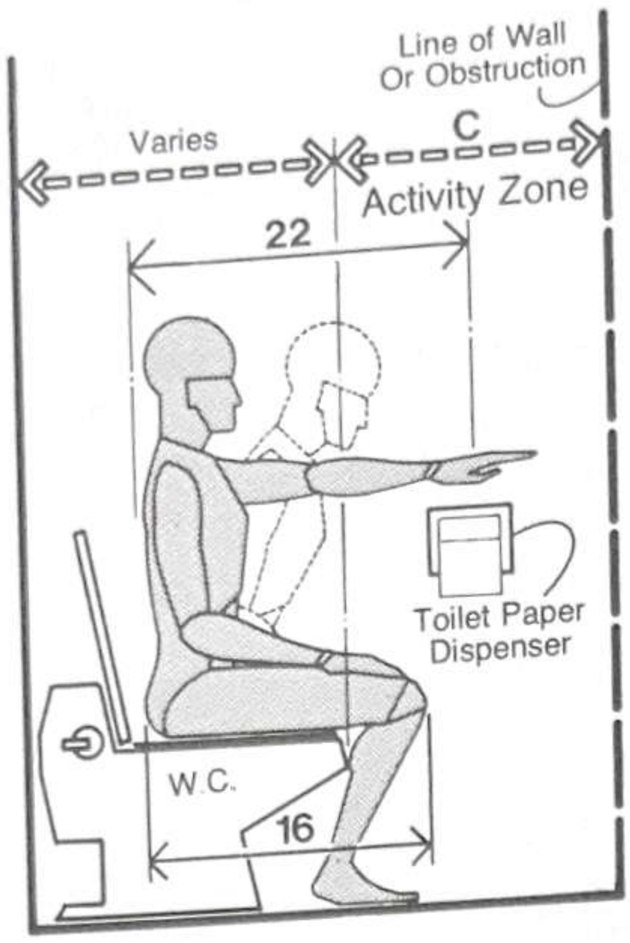
Printed in China

2.5 BATHROOMS

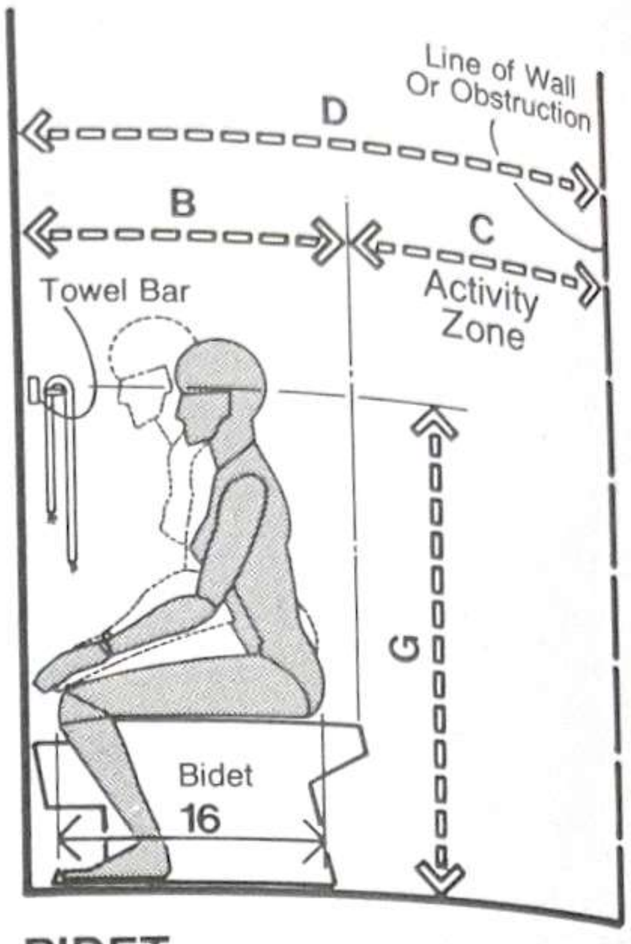
The drawings at the top and center of the page deal with the anthropometric considerations related to the individual water closet and bidet. The drawing at the top left suggests an activity zone or clearance between the face of a water closet to the line of the wall or nearest obstruction of at least 24 in, or 61 cm. Accessories in front or to the side of the user should be within reach. Thumb tip arm reach and side arm reach should both be taken into account in locating these items anthropometrically. A height of about 30 in, or 76.2 cm, from the floor to the center line of the paper dispenser is suggested.

The bottom drawing of the water closet shows some of the horizontal clearances required.

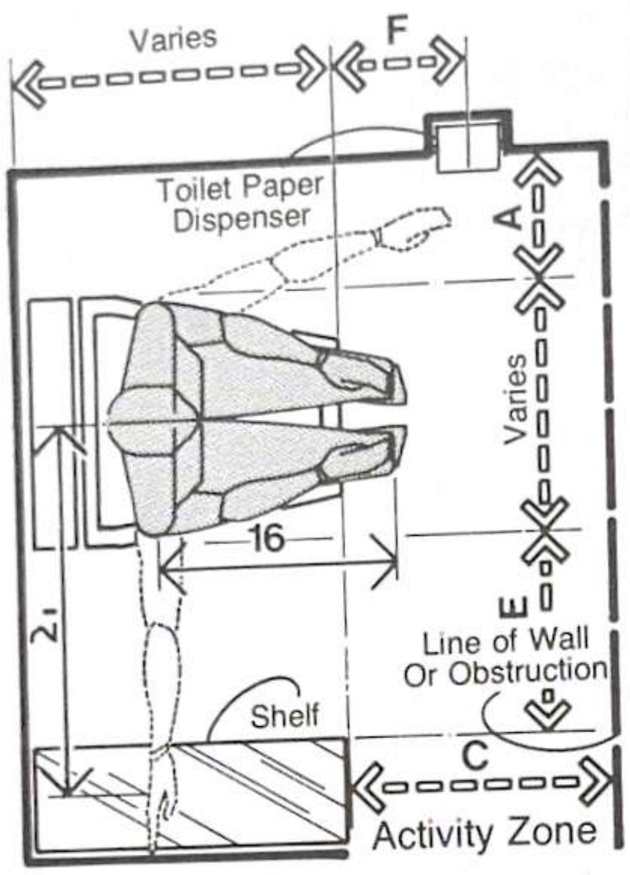
The two drawings of the individual bidet illustrate in a similar manner some of the basic anthropometric requirements and clearances suggested for a typical installation. The bottom drawing indicates some of the clearances involved when the water closet and bidet are located side by side.



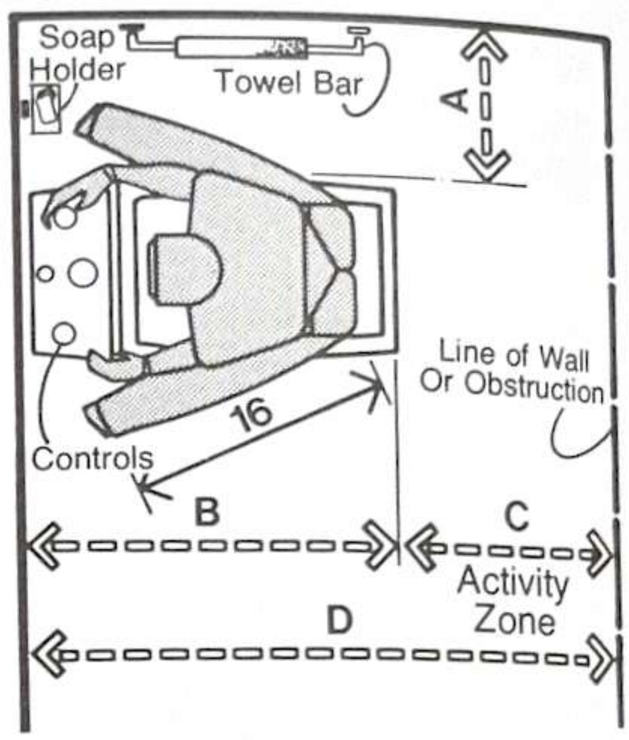
WATER CLOSET



BIDET

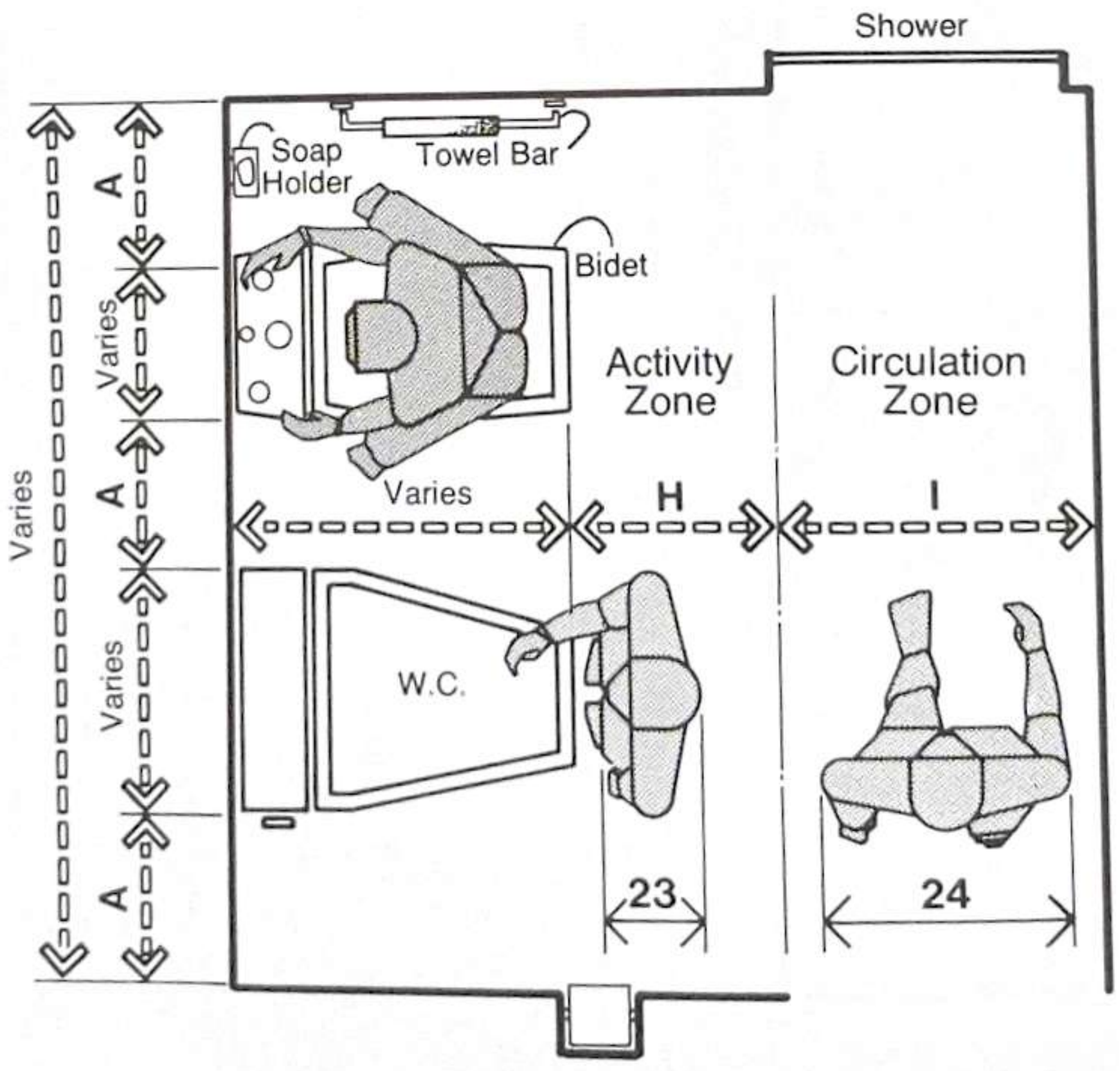


WATER CLOSET

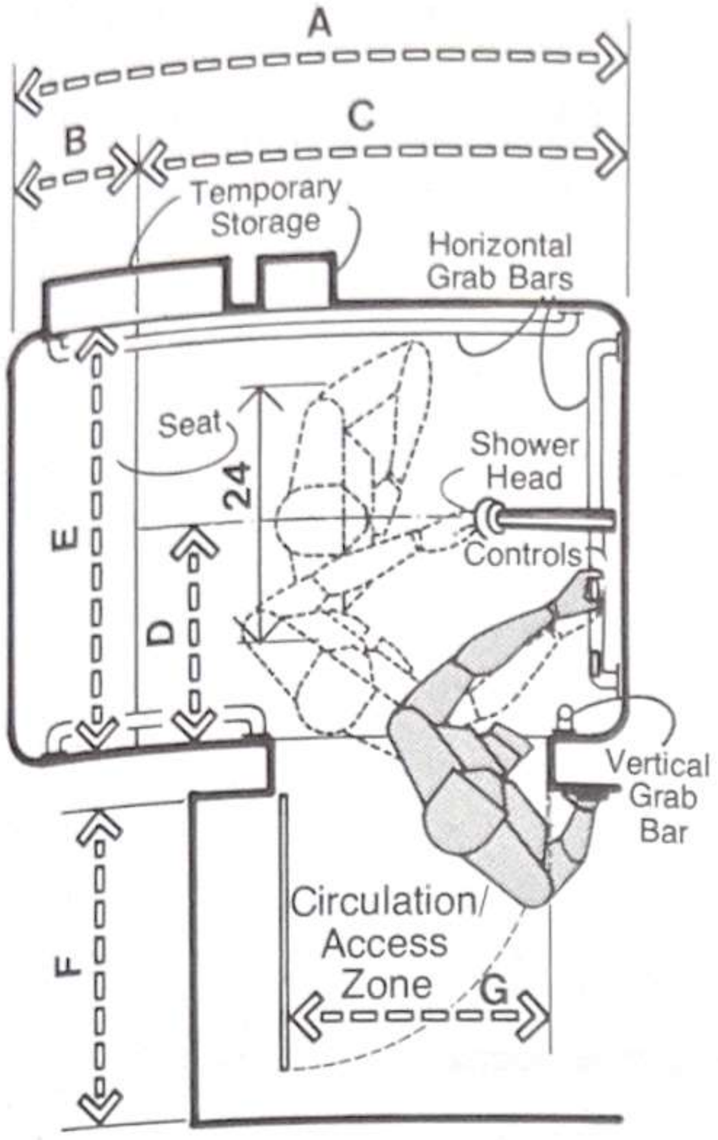


BIDET

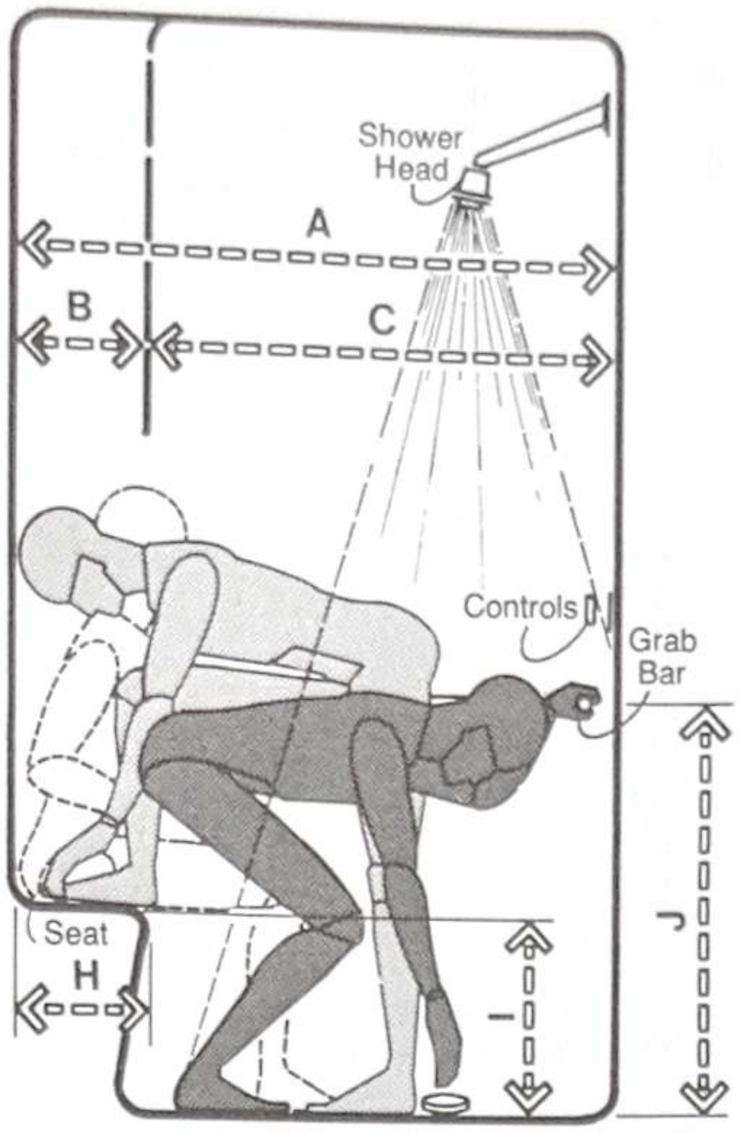
	in	cm
A	12 min.	30.5 min.
B	28 min.	71.1 min.
C	24 min.	61.0 min.
D	52 min.	132.1 min.
E	12–18	30.5–45.7
F	12	30.5
G	40	101.6
H	18	45.7
I	30	76.2



BIDET AND WATER CLOSET



MINIMUM SHOWER CLEARANCES

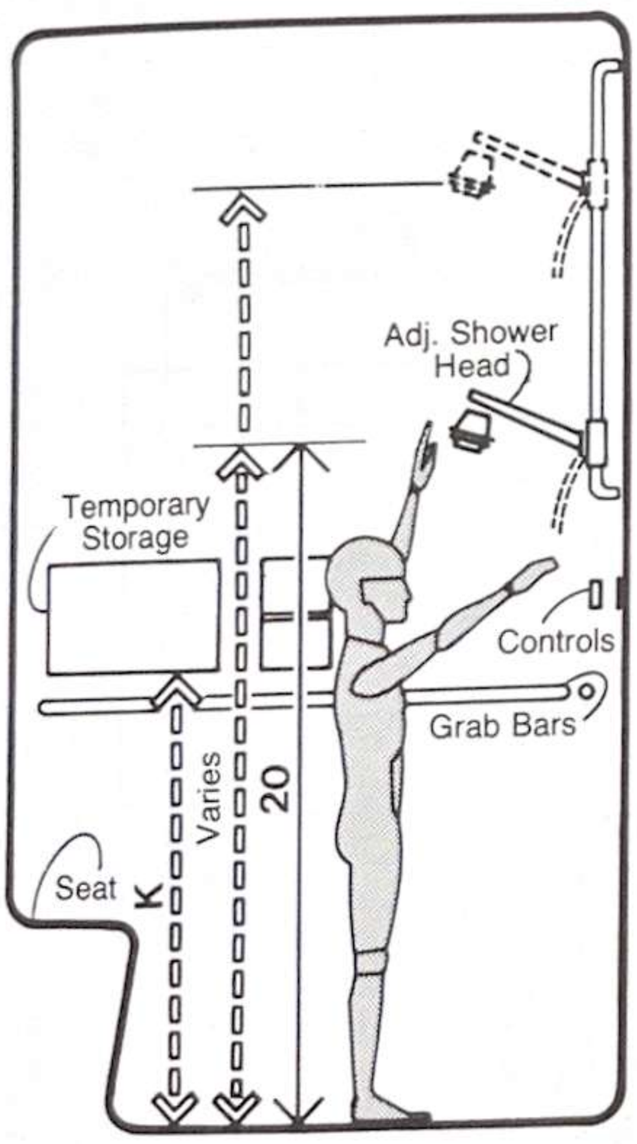


MINIMUM SHOWER CLEARANCES

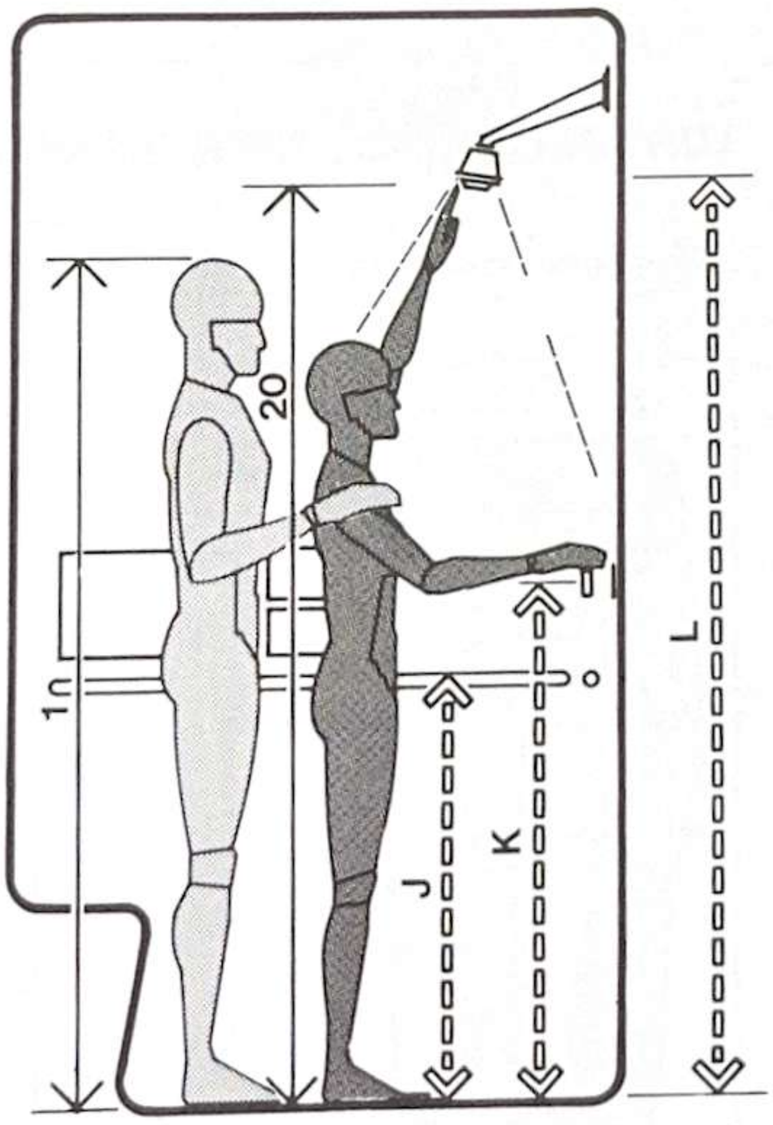
2.5 BATHROOMS

The size of a shower stall can vary greatly depending on the level of comfort desired. Safety is also an extremely important consideration. Unless a fairly reliable mixing valve capable of presetting a fixed and desirable water temperature is provided, care should be taken to locate controls within reach but out of direct line of the water path in order to avoid scalding or freezing while operating the controls.

A clearance of 54 in, or 137.2 cm, between walls, as shown in the two drawings at the top, will not only accommodate the variety of body positions shown, but will also allow for a small 12-in, or 30.5-cm, seating surface. The height of the adjustable shower head should be within reach of the adult of smaller body size, but at the same time high enough to clear the head of most people of larger body size. In situations where children use the same facility, an adjustable shower head is suggested in order to place it within reach of the child.



SHOWER/CHILD ANTHROPOMETRIC CONSIDERATIONS



SHOWER/REACH AND CLEARANCE

	in	cm
A	54	137.2
B	12	30.5
C	42 min.	106.7 min.
D	18	45.7
E	36 min.	91.4 min.
F	30	76.2
G	24	61.0
H	12 min.	30.5 min.
I	15	38.1
J	40–48	101.6–121.9
K	40–50	101.6–127.0
L	72 min.	182.9 min.

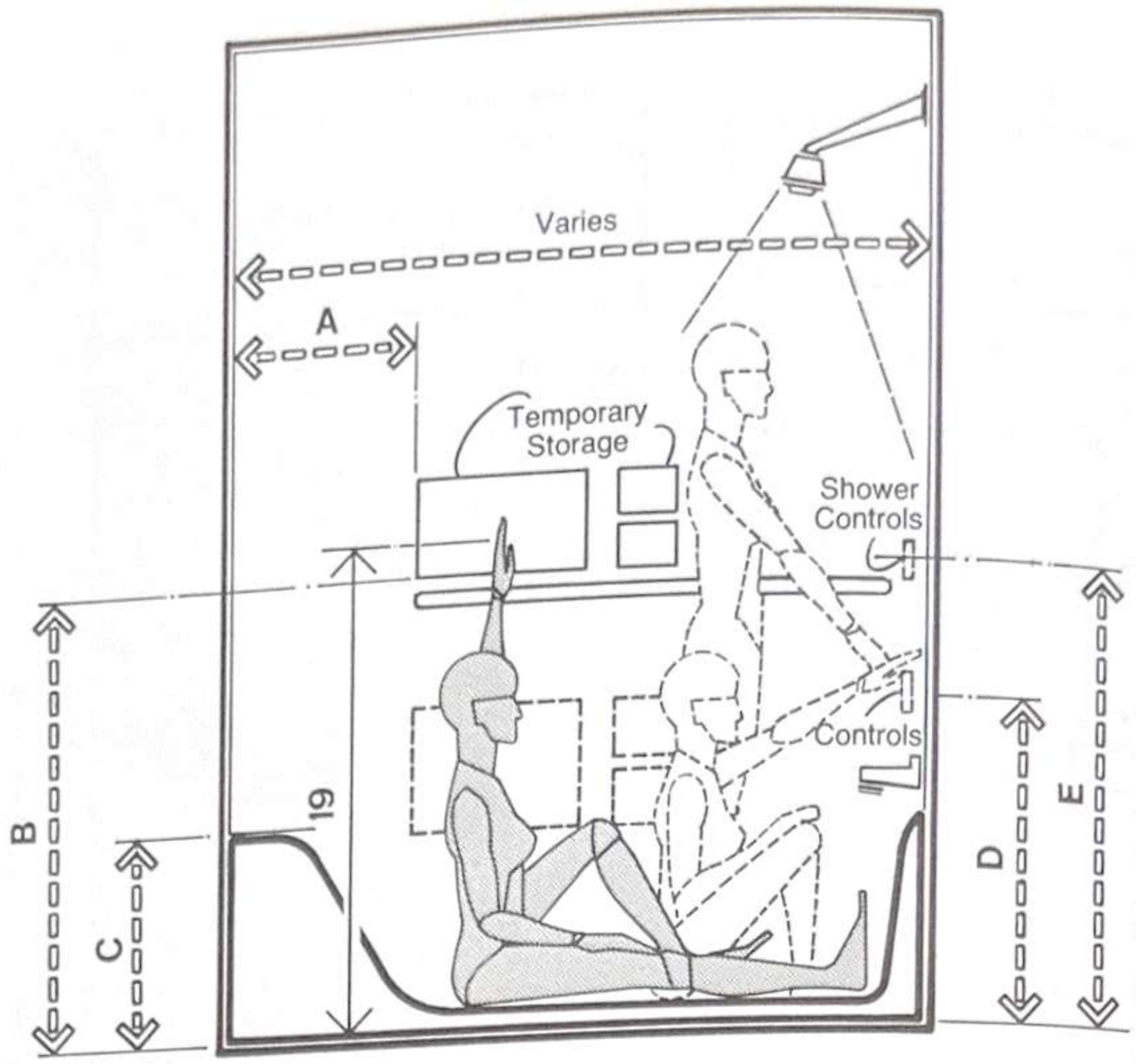
Printed in China

2.5 BATHROOMS

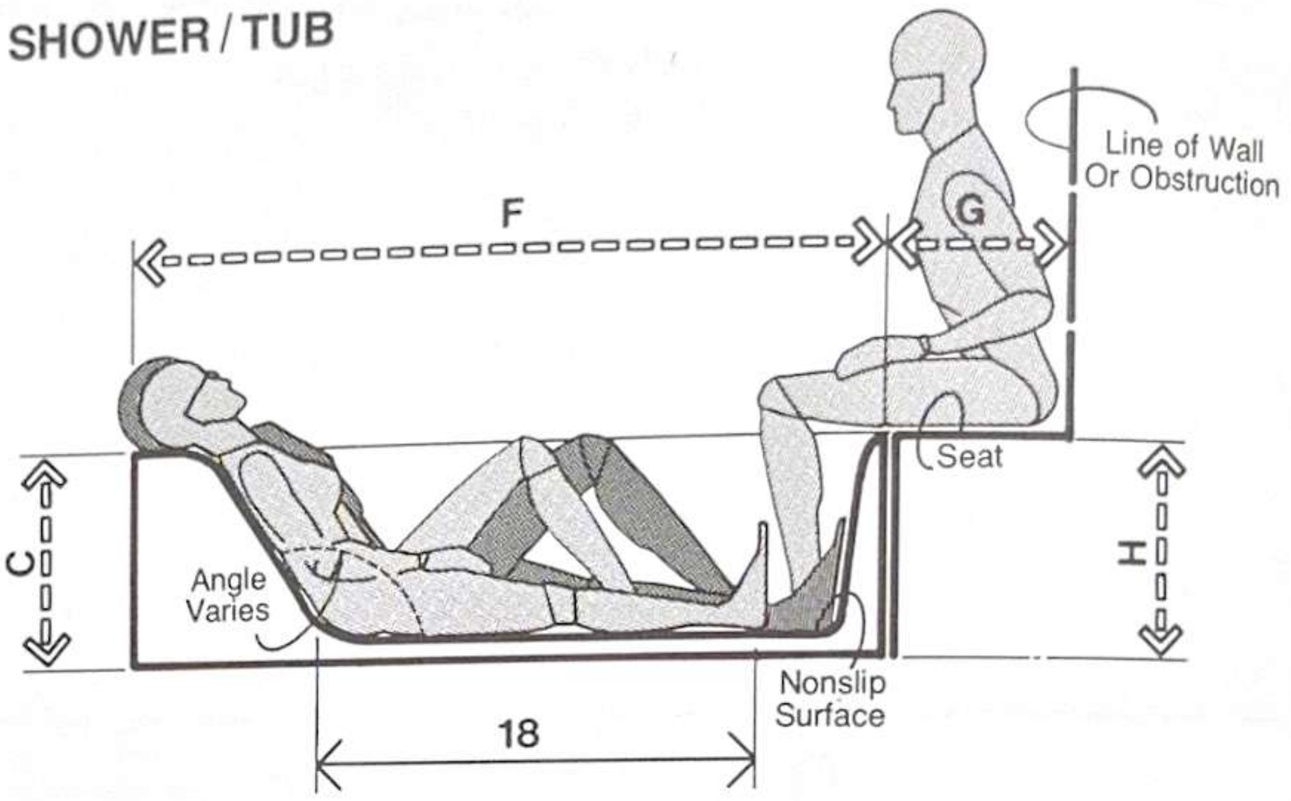
The drawing at the top of the page illustrates some of the basic clearances required for a combination shower and tub. Dimensions concerning the shower head are similar to those indicated on the preceding page. The location of the tub controls should be placed within reach of the smaller seated user.

Unless a tub is custom designed, the choice of dimensions is limited to standard available tub models. A knowledge of the anthropometric considerations involved, however, will prove helpful in making the appropriate selection. If the user enjoys reclining and soaking for extended periods, a large-size tub may not necessarily be the wisest selection. The length of the tub at the bottom surface should approximate the buttock-heel length of the smaller user. This will allow the feet to bear against the end of the tub and act as a brace to prevent the body from sliding too far under the water.

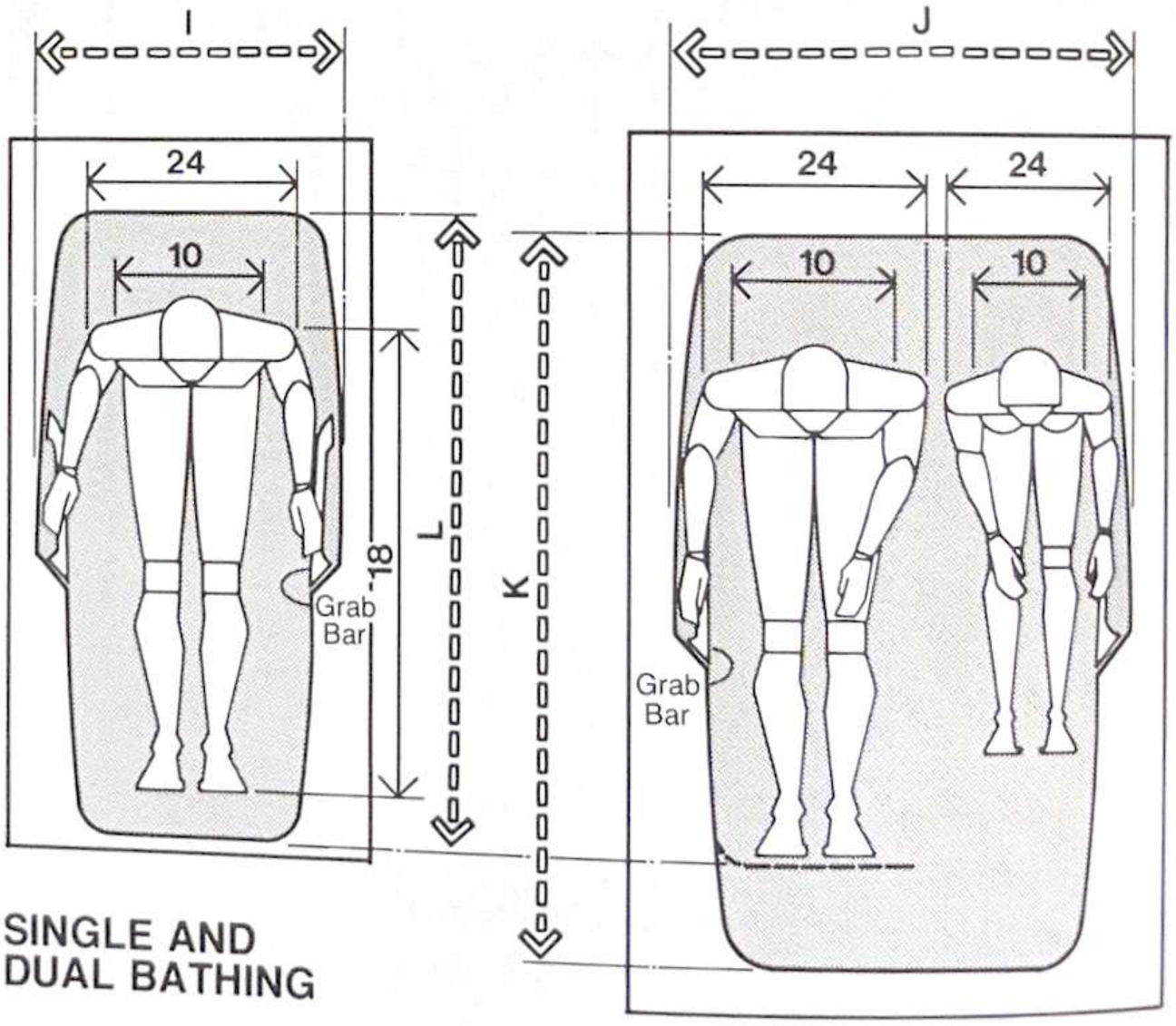
The center drawing illustrates that condition. The bottom drawing indicates that a tub width of 40 to 44 in, or 101.6 to 111.8 cm, is necessary to accommodate two people in the tub at the same time.



SHOWER / TUB



TUB / RECLINING AND RELAXING



SINGLE AND DUAL BATHING

	in	cm
A	18–21	45.7–53.3
B	40	101.6
C	15–22	38.1–55.9
D	30–34	76.2–86.4
E	40–50	101.6–127.0
F	66	167.6
G	12 min.	30.5 min.
H	18 max.	45.7 max.
I	26–27	66.0–68.6
J	40–44	101.6–111.8
K	66–70	167.6–177.8
L	56–60	142.2–152.4

3 OFFICE SPACES

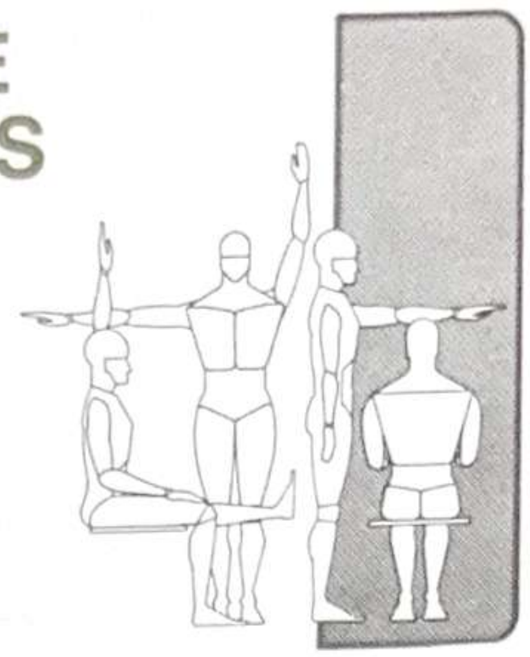


TABLE	3.1 PRIVATE OFFICE	3.2 GENERAL OFFICE	3.3 RECEPTION	3.4 CONFERENCE	SPACE / ANTHROPOMETRIC DATA
1A,2B		●	●		1 STATURE
1B,3C		◑	◑		2 EYE HEIGHT
1C,3B		◑			3 ELBOW HEIGHT
					4 SITTING HEIGHT ERECT
1E,2D		◑			5 SITTING HEIGHT NORMAL
1F,3G	◑	◑	◑	◑	6 EYE HEIGHT SITTING
					7 MIDSHOULDER HEIGHT SITTING
					8 SHOULDER BREADTH
					9 ELBOW-TO-ELBOW BREADTH
1J,2F	●		●		10 HIP BREADTH
					11 ELBOW REST HEIGHT
1L,2H	●	●	●	●	12 THIGH CLEARANCE
1M,2I	●	◑		●	13 KNEE HEIGHT
1N,2J	◑	◑		◑	14 POPLITEAL HEIGHT
1O,2K	◑	◑		◑	15 BUTTOCK-POPLITEAL LENGTH
1P,2L	●	◑	●	●	16 BUTTOCK-KNEE LENGTH
1Q,3F		●			17 BUTTOCK-TOE LENGTH
					18 BUTTOCK-HEEL LENGTH
1S,4C					19 VERTICAL REACH HEIGHT SITTING
1T,4F					20 VERTICAL GRIP REACH
1U,4E	○		○		21 SIDE ARM REACH
1V,4D		●			22 THUMB TIP REACH
1W,6B	●	●	●	●	23 MAXIMUM BODY DEPTH
1X,6A	●	●	●	●	24 MAXIMUM BODY BREADTH

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Since the 1950s, office design has become one of the major areas of specialization for the designer. Millions of square feet of office space are designed each year. The proliferation of business and the ensuing demand for large corporation headquarters resulted in the need to plan spaces capable of housing hundreds and even thousands of people within the same space. People spend nearly half their waking hours within an office environment of one type or another. Some may literally spend an entire lifetime in the employ of the same firm. Expanding world markets will create an even greater demand for more space. Moreover, as technology changes, its impact on the methodology of transacting business and the systems involved will necessitate further recycling of existing office spaces to respond to new needs. Concurrently, spiraling costs of construction and land acquisition, increasing scarcity of available urban building sites, and higher production costs will place greater demands on the designer for efficient, cost-conscious, and economical utilization of office space.

The reconciliation of economic imperatives and human factors within the design process will require a greater sensitivity and awareness on the part of the designer to the relationship of human dimension and interior space. Accordingly, the anthropometric implications of people's relationship to various aspects of the office environment, such as conference rooms, private and general offices, and reception areas, are explored in the pages that follow. Clearances between desks, heights of worksurfaces, human reach limitations, human requirements for paths of circulation are all investigated and diagrammed both in plan and section.

3.1 THE PRIVATE OFFICE

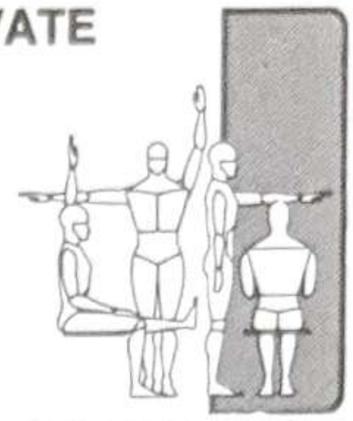


TABLE	DESK	LOUNGING	STORAGE	CIRCULATION	ACTIVITIES / ANTHROPOMETRIC DATA
1F,3G	◐				6 EYE HEIGHT SITTING
1J,2F	●	●			10 HIP BREADTH
1L,2H	●				12 THIGH CLEARANCE
1M,2I	●				13 KNEE HEIGHT
1N,2J	◐				14 POPLITEAL HEIGHT
1O,2K	◐				15 BUTTOCK-POPLITEAL LENGTH
1P,2L	●	●			16 BUTTOCK-KNEE LENGTH
1U,4E			○		21 SIDE ARM REACH
1W,6B		●		●	23 MAXIMUM BODY DEPTH
1X,6A	●	●		●	24 MAXIMUM BODY BREADTH

The design of certain aspects of private office spaces involves many of the same considerations related to human dimension and body size as were explored in certain aspects of residential spaces. The most important component of the private office space, or any office space for that matter, is the desk itself and related elements. Considering that the user may well spend over half of his waking hours within the immediate workspace, the importance of ensuring a designed environment responsive to human dimension assumes added significance.

The relationship of human dimension to the executive chair was examined in detail in Section 1, while the general anthropometric theory regarding seating was explored in Section 4 of Part A. Although the drawings indicate the importance of certain body dimensions, including popliteal height and buttock-popliteal length related to the chair, it is the relationship of the seated person to the desk itself that is stressed. In this regard, the importance of thigh clearance and knee height in ensuring proper clearance from the top of the seat to the underside of the desk is illustrated and minimum dimensions suggested. Clearances around the desk, the importance of an overhanging desk top for informal desk conferences, the clearances behind the desk so that credenza and file can be within reach are all reflected in the many design situations examined in the drawings on the following pages. The more significant body measurements to be considered are indicated in the matrix above.

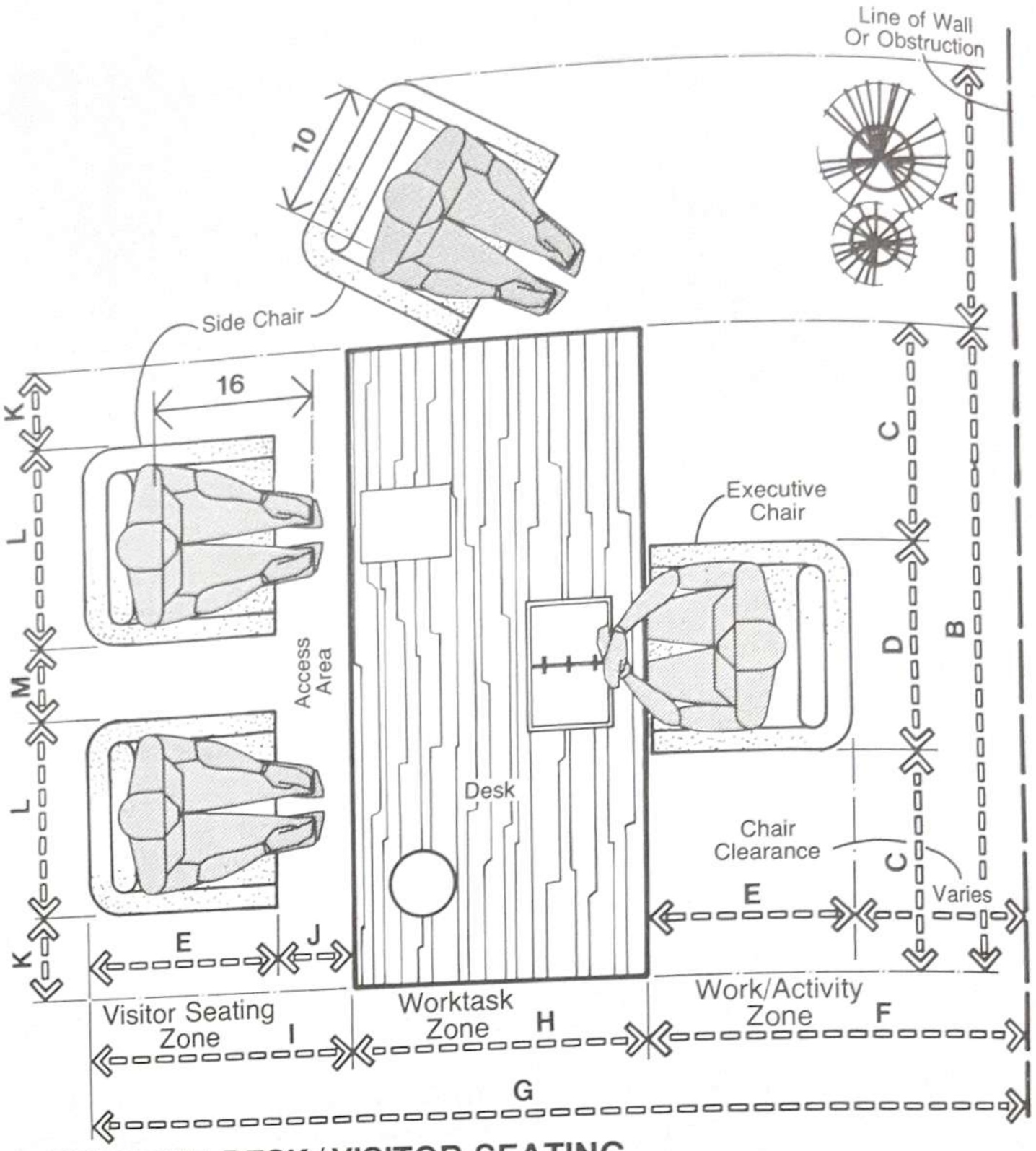
Printed in China

3.1 THE PRIVATE OFFICE

The drawing at the top illustrates the basic dimensional requirements of an executive workstation with visitor seating for three. While image and scale often dictate the size of the executive desk and the placement of the furniture around it, the generally accepted size suggested is 30 to 45 by 66 to 84 in, or 76.2 to 114.3 by 167.6 to 213.4 cm. The specific work habits of the executive and the nature of his or her business must be considered in determining the appropriate worksurface measurements.

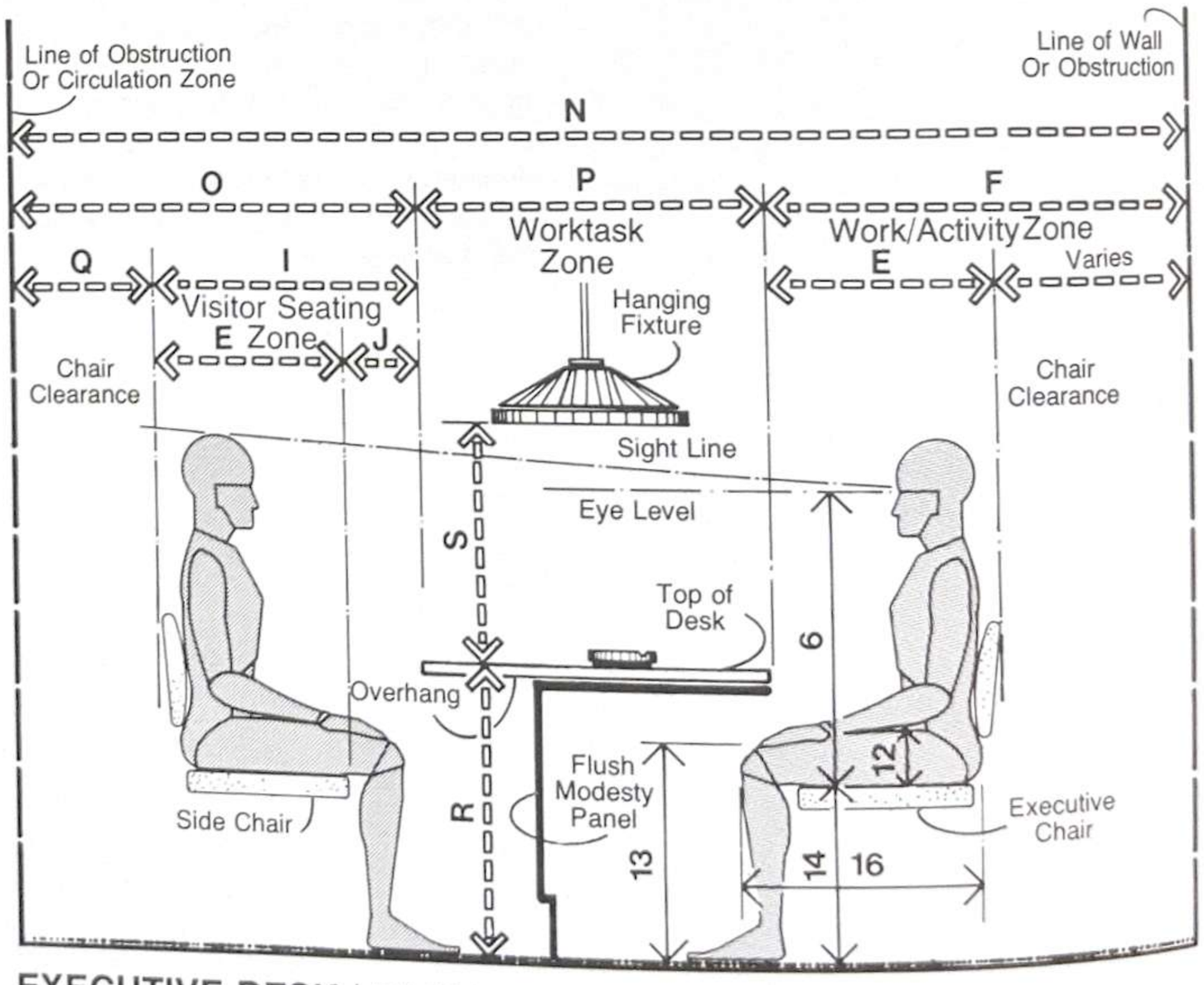
Critical attention must be given to the selection, placement, and clearances provided for seating around the desk. Both drawings indicate the need to carefully consider the buttock-knee length, hip breadth, and maximum body breadth measurements. The dimensions for the various zones and clearances, while predicated on basic anthropometric considerations, are often a function of circulation within the space and the furniture type.

Buttock-toe length as well as body depth determines placement of a visitor's chair in front of the desk, with the distance from the desk often a function of whether the desk has an overhang. Placement of a hanging fixture must relate to an appropriate determination of eye level and sight lines.

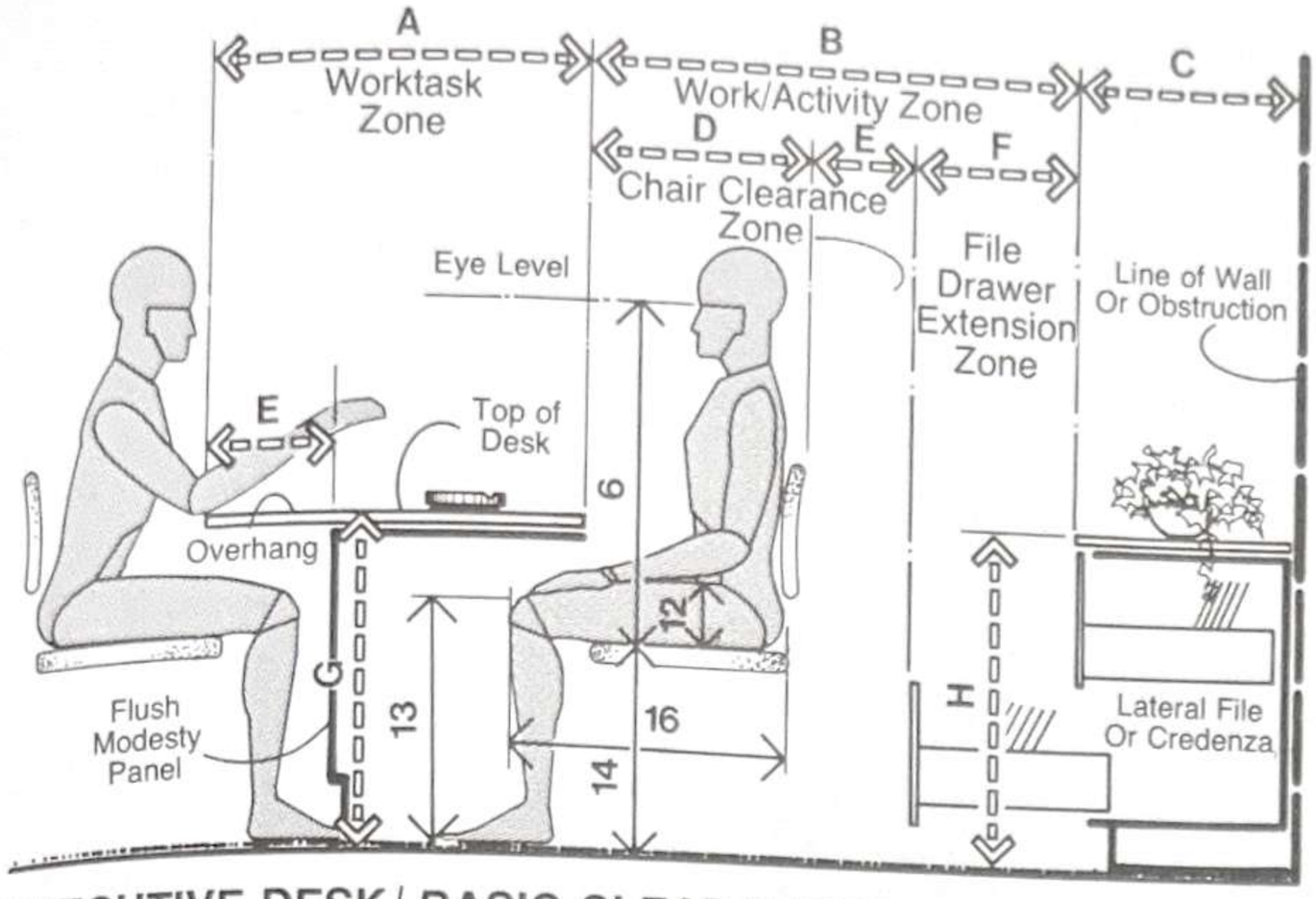


EXECUTIVE DESK / VISITOR SEATING

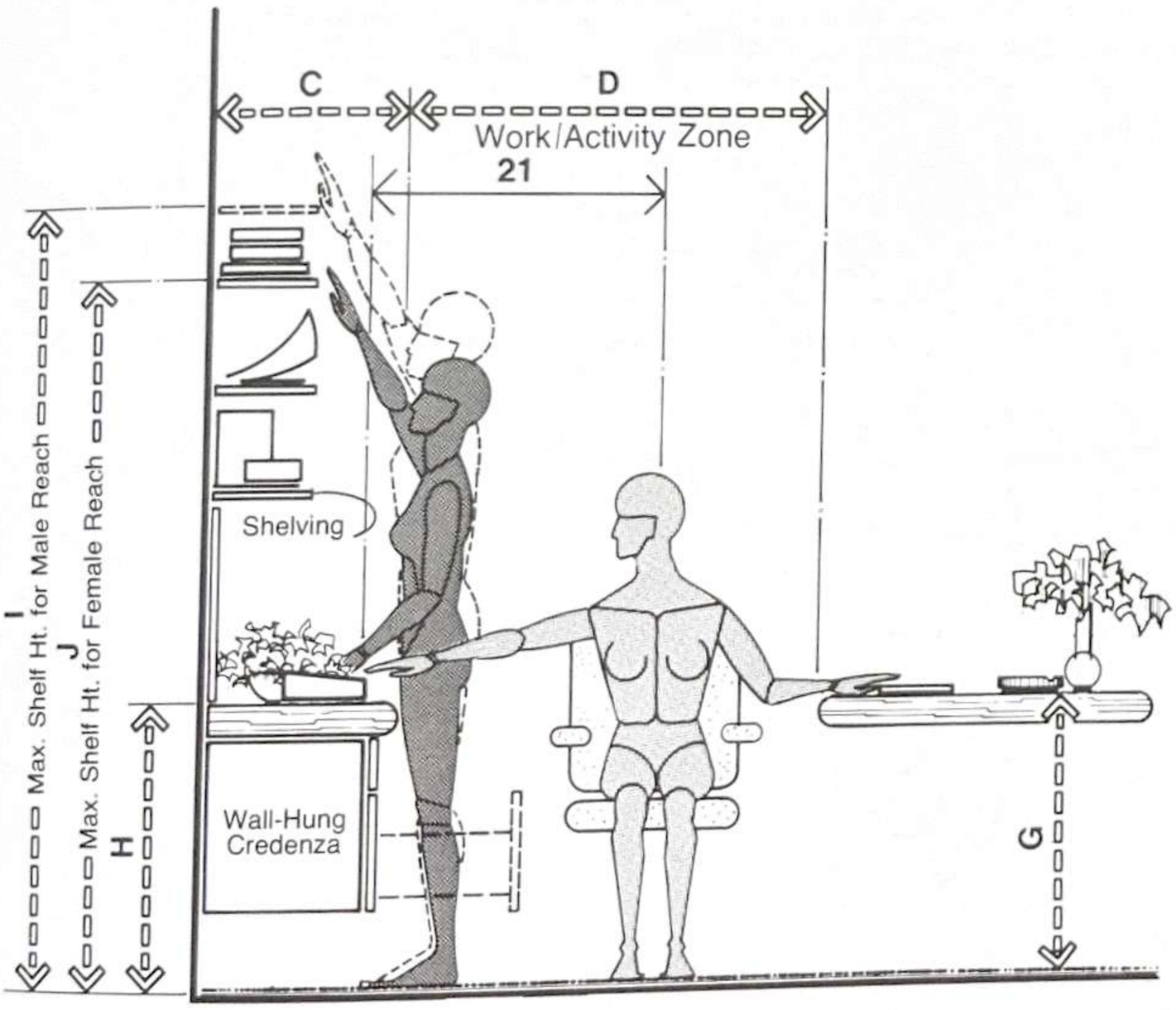
	in	cm
A	30–39	76.2–99.1
B	66–84	167.6–213.4
C	21–28	53.3–71.1
D	24–28	61.0–71.1
E	23–29	58.4–73.7
F	42 min.	106.7 min.
G	105–130	266.7–330.2
H	30–45	76.2–114.3
I	33–43	83.8–109.2
J	10–14	25.4–35.6
K	6–16	15.2–40.6
L	20–26	50.8–66.0
M	12–15	30.5–38.1
N	117–148	297.2–375.9
O	45–61	114.3–154.9
P	30–45	76.2–114.3
Q	12–18	30.5–45.7
R	29–30	73.7–76.2
S	22–32	55.9–81.3



EXECUTIVE DESK / BASIC CLEARANCES



EXECUTIVE DESK/ BASIC CLEARANCES



EXECUTIVE DESK/
CREDENZA CONSIDERATIONS

3.1 THE PRIVATE OFFICE

The use of the overhangs, shown on the top drawing, can make a desk suitable for a small conference. As indicated, both knee and toe clearances are a factor. A 42-in, or 106.7-cm, minimum dimension is recommended for the work/activity zone. However, if filing or storage units are provided behind this zone, additional space should be allocated for drawer extension and door swings. In many instances, the work/activity zone distance is also determined by the size of the executive chair, its tilt and swivel mobility, and the work habits of the executive. Side arm reach, as shown in the bottom drawing is often critical in establishing the work/activity zone if specific business equipment, such as calculators, telephones, keyboards, must be within easy reach. The height of the desk as well as that of the credenza behind it will vary from manufacturer to manufacturer. Popliteal height, knee height, and thigh clearance should always be considered in establishing the relationship between seat height and desk height.

Frequently, the executive workstation will be provided with a credenza behind the desk, with vertical storage or shelving above. Assuming that ease of access to the top shelf is of importance, it is recommended that the maximum shelf height to accommodate male reach be no greater than 72 in, or 182.9 cm, and for female reach no greater than 69 in, or 175.3 cm.

	in	cm
A	30–45	76.2–114.3
B	42 min.	106.7 min.
C	18–24	45.7–61.0
D	23–29	58.4–73.7
E	5–12	12.7–30.5
F	14–22	35.6–55.9
G	29–30	73.7–76.2
H	28–30	71.1–76.2
I	72 max.	182.9 max.
J	69 max.	175.3 max.

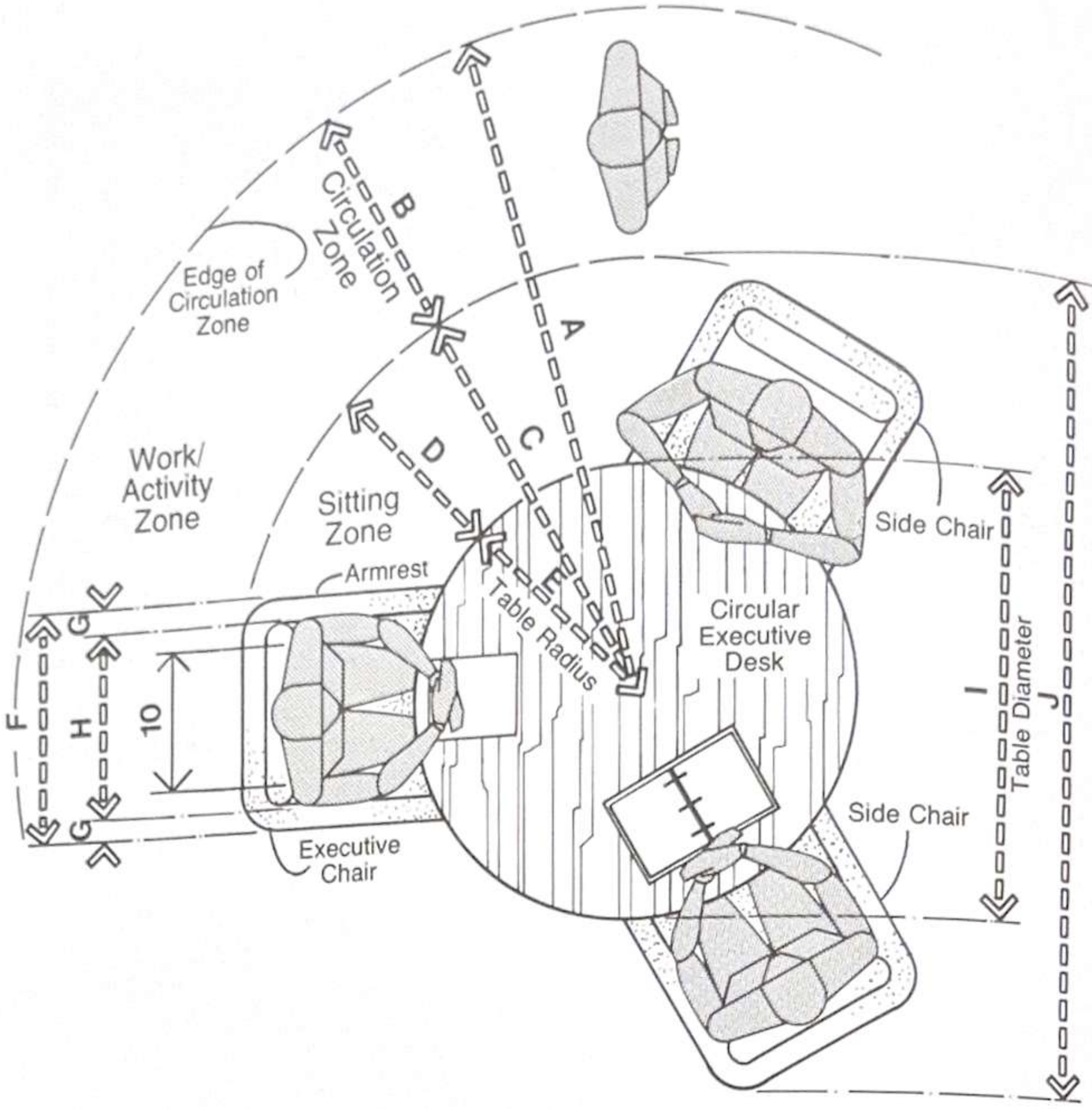
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3.1 THE PRIVATE OFFICE

Many private executive offices are being designed with desks that do not conform with the basic rectangular shape. Such a situation is illustrated in the drawing at the top which shows a circular executive desk. Such a desk is often selected if the executive in question plans to hold conferences within the office and prefers the psychology of having either visitors or employees gather around the worksurface in an egalitarian fashion. While a minimum desk size of 48 in, or 121.9 cm, is shown, this dimension is also influenced by the number of side chairs to be grouped around the desk.

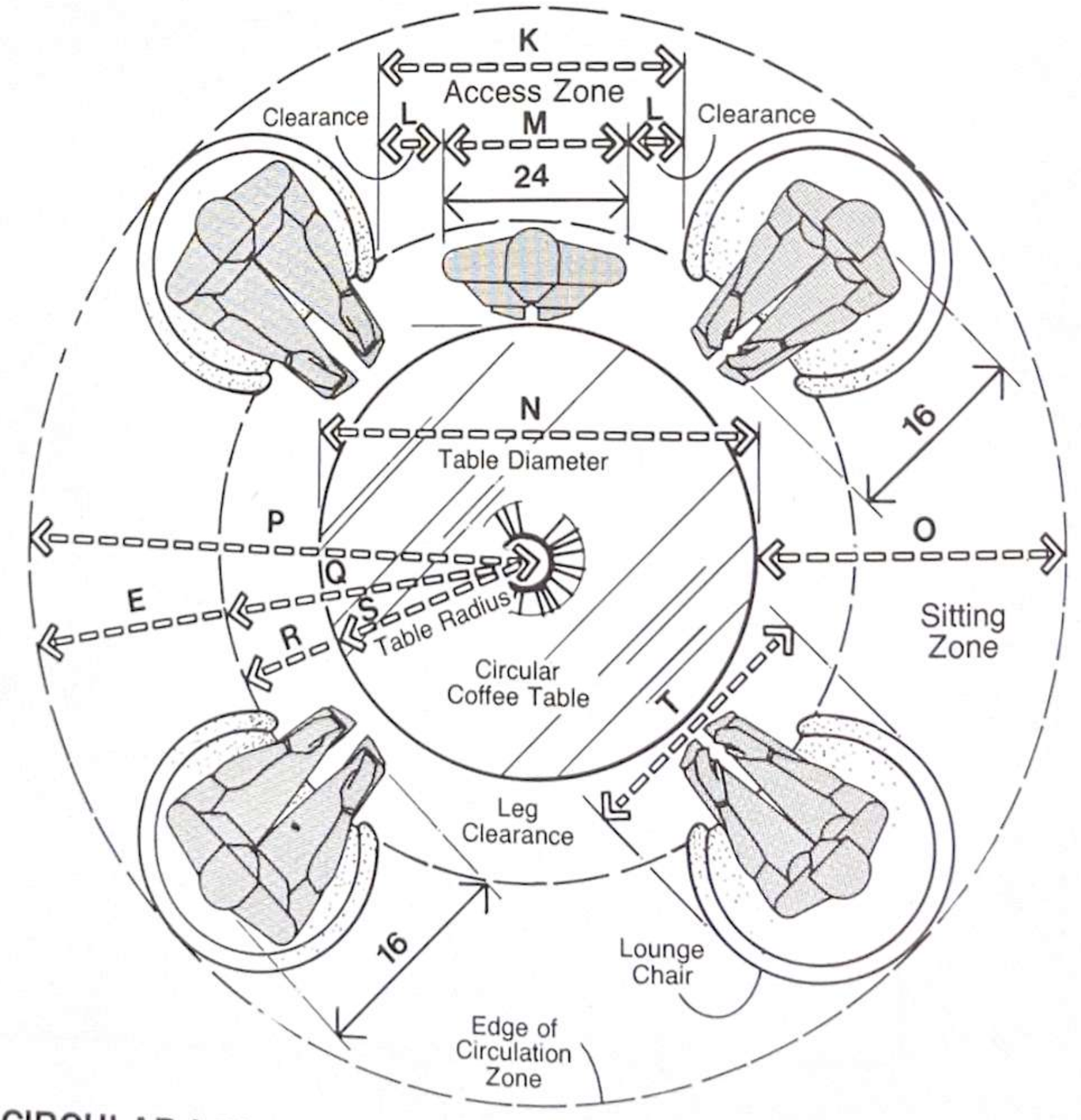
A circular executive desk must be supported by supplementary credenza or file storage within easy reach of the executive chair. Side arm reach relative to the work/activity zone must always be studied carefully.

The drawing at the bottom illustrates a typical circular lounge grouping found within an executive office. Providing for the appropriate leg clearance of 12 to 18 in, or 30.5 to 45.7 cm, is also determined by the sitting zone requirements. Buttock-knee length must also be considered.



CIRCULAR EXECUTIVE DESK

	in	cm
A	77–88	195.6–223.5
B	30	76.2
C	46–58	116.8–147.3
D	22–28	55.9–71.1
E	24–30	61.0–91.4
F	24–28	61.0–71.1
G	2–3	5.1–7.6
H	20–22	50.8–55.9
I	48–60	121.9–152.4
J	92–116	233.7–294.6
K	36–42	91.4–106.7
L	6–9	15.2–22.9
M	24	61.0
N	42–60	106.7–152.4
O	36–48	91.4–121.9
P	57–78	144.8–198.1
Q	33–48	83.8–121.9
R	12–18	30.5–45.7
S	21–30	53.3–76.2
T	24–32	61.0–81.3



CIRCULAR LOUNGE GROUPING

3.2 THE GENERAL OFFICE

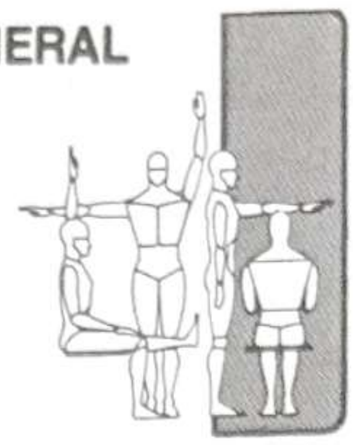


TABLE	WORKSTATION	FILING	VISUAL	CIRCULATION	ACTIVITIES	ANTHROPOMETRIC DATA
1A,2B	◪		◪			1 STATURE
1B,3C	◪	◪	◪			2 EYE HEIGHT
1C,3B	◪	◪				3 ELBOW HEIGHT
1E,2D	◪		◪			5 SITTING HEIGHT NORMAL
1F,3G	◪	◪	◪			6 EYE HEIGHT SITTING
1L,2H	●					12 THIGH CLEARANCE
1M,2I	◪					13 KNEE HEIGHT
1N,2J	◪					14 POPLITEAL HEIGHT
1O,2K	◪					15 BUTTOCK-POPLITEAL LENGTH
1P,2L	◪					16 BUTTOCK-KNEE LENGTH
1Q,3F	●					17 BUTTOCK-TOE LENGTH
1V,4D	○					22 THUMB TIP REACH
1W,6B	●	●		●		23 MAXIMUM BODY DEPTH
1X,6A	●	●		●		24 MAXIMUM BODY BREADTH

In the general office as well as the private one, the interface between the seated user and the desk is of central importance. The quality of interface between user and workstation will determine the general comfort and well-being of the office staff and the efficiency of production within the office space.

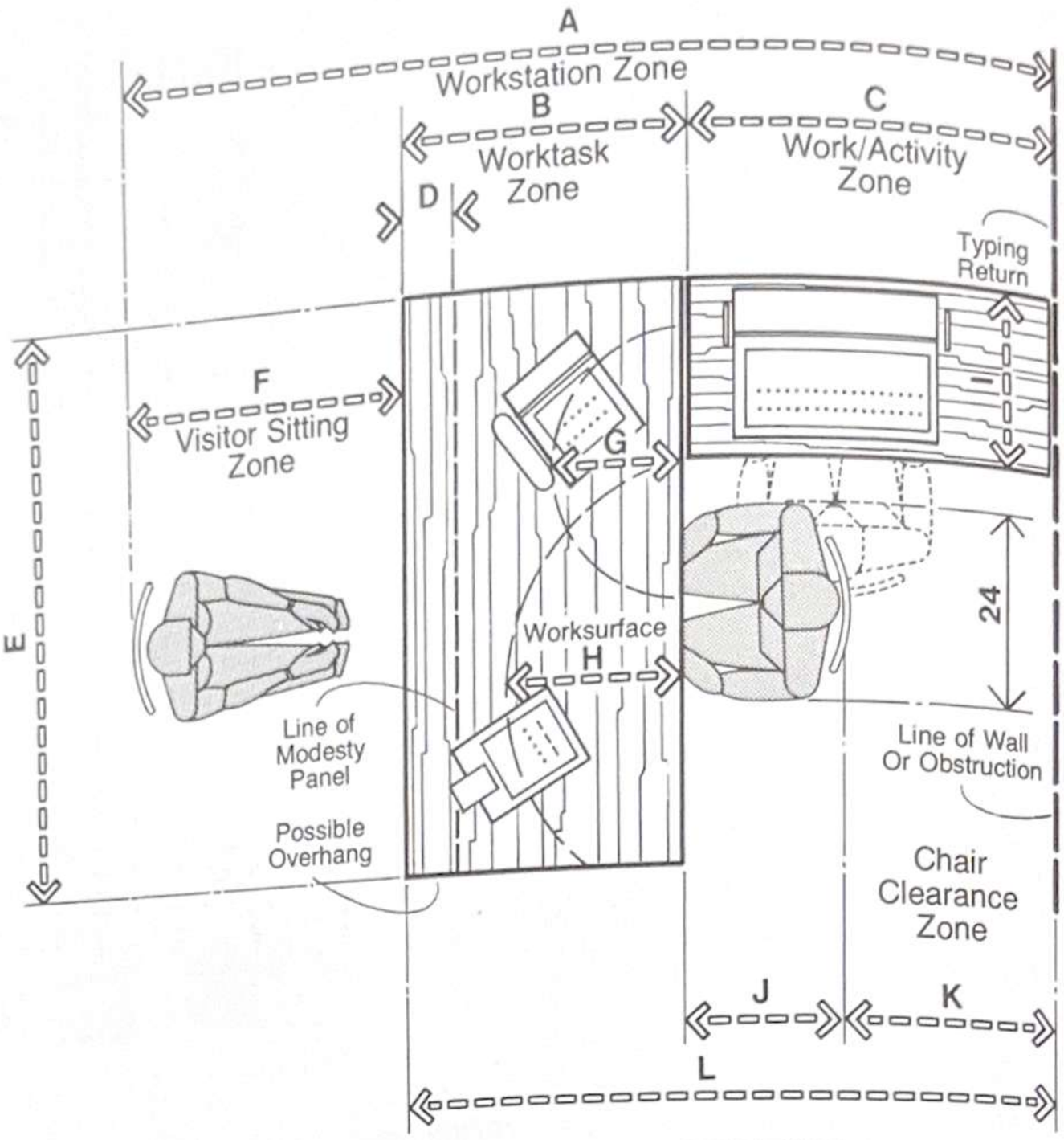
The proper design of the secretarial chair, its seat height in relation to the popliteal height of the user and the top of the typing return, appropriate backrest design to ensure positive lumbar support, proper height of overhead storage, side arm reach and forward arm reach dimensions of the majority of the users are all extremely critical anthropometric considerations to take into account in the design of general office spaces. Clearance for circulation within general office spaces should accommodate the maximum body breadth and depth of those of larger body size. The relationship of human dimension and body size of the seated person to the filing cabinet is yet another consideration. Eye height of the standing and seated user in relationship to the height of a low partition in an open plan system is one more anthropometric factor to consider. Of importance also is the recognition of the great range in body size between the large and small male, the large and small female, and the large male and small female.

The foregoing considerations are included among the specific design situations examined in the drawings on the following pages, and dimensional data are suggested for use in making preliminary design assumptions. The basic anthropometric measurements to be considered are indicated in the matrix above.

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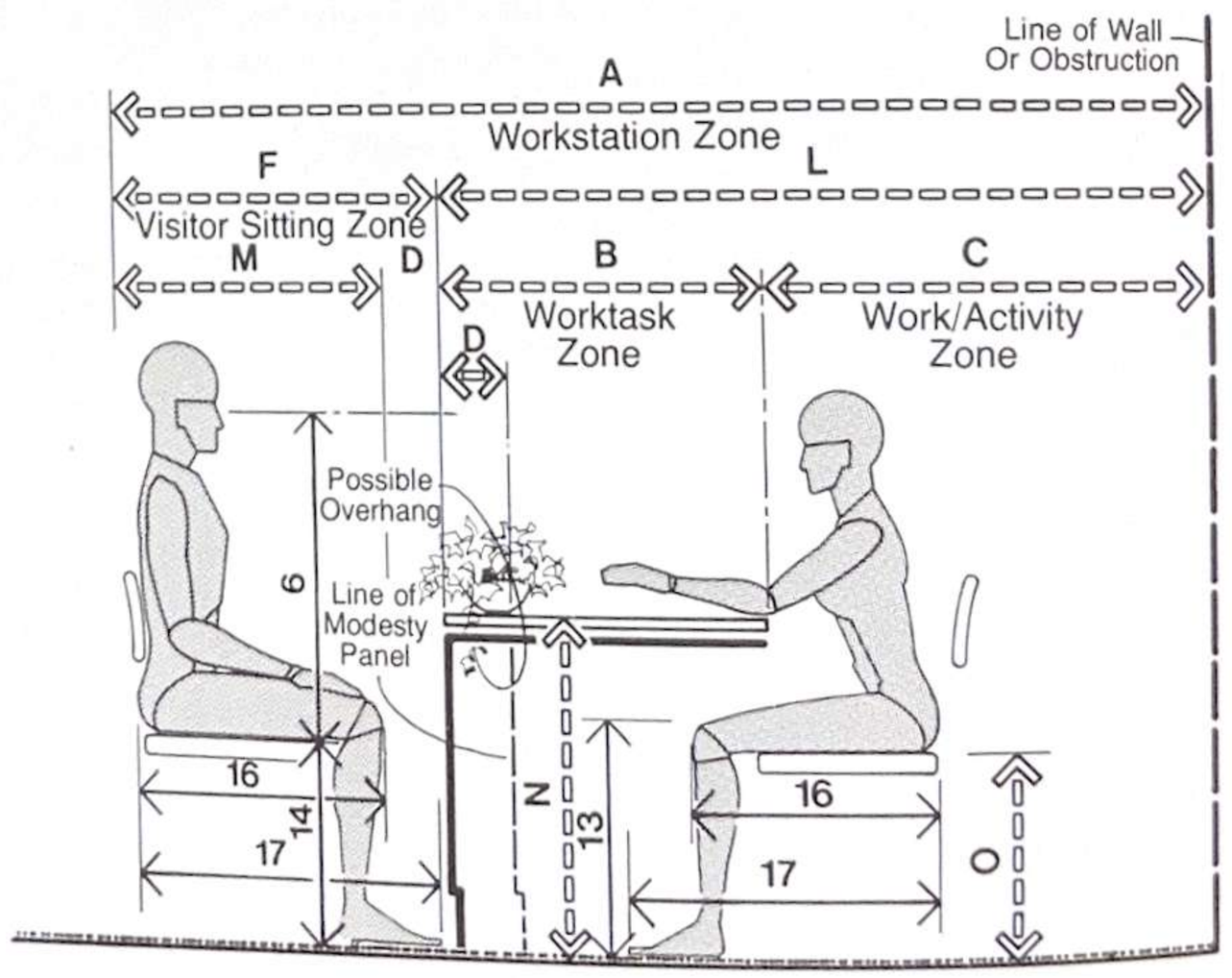
3.2 GENERAL OFFICE

The basic workstation, as illustrated in both plan and section on this page, is the fundamental building block in understanding the anthropometric considerations for the planning and design of the general office. The worktask zone must be large enough to accommodate the paperwork, equipment, and other accessories that support the user's function. The work/activity zone dimension, shown on the top drawing, is established by the space requirements needed for use of the typical return. In no case should this distance be less than the 30 in, or 76.2 cm, needed to provide adequate space for the chair clearance zone. The visitor seating zone, ranging in depth from 30 to 42 in, or 76.2 to 106.7 cm, requires the designer to accommodate both the buttock-knee and buttock-toe length body dimensions of the larger user. If an overhang is provided or the desk's modesty panel is recessed, the visitor seating zone can be reduced due to the additional knee and toe clearances provided. The specific type and size of the seating (i.e., if it swivels or if it has casters) also influence these dimensions.

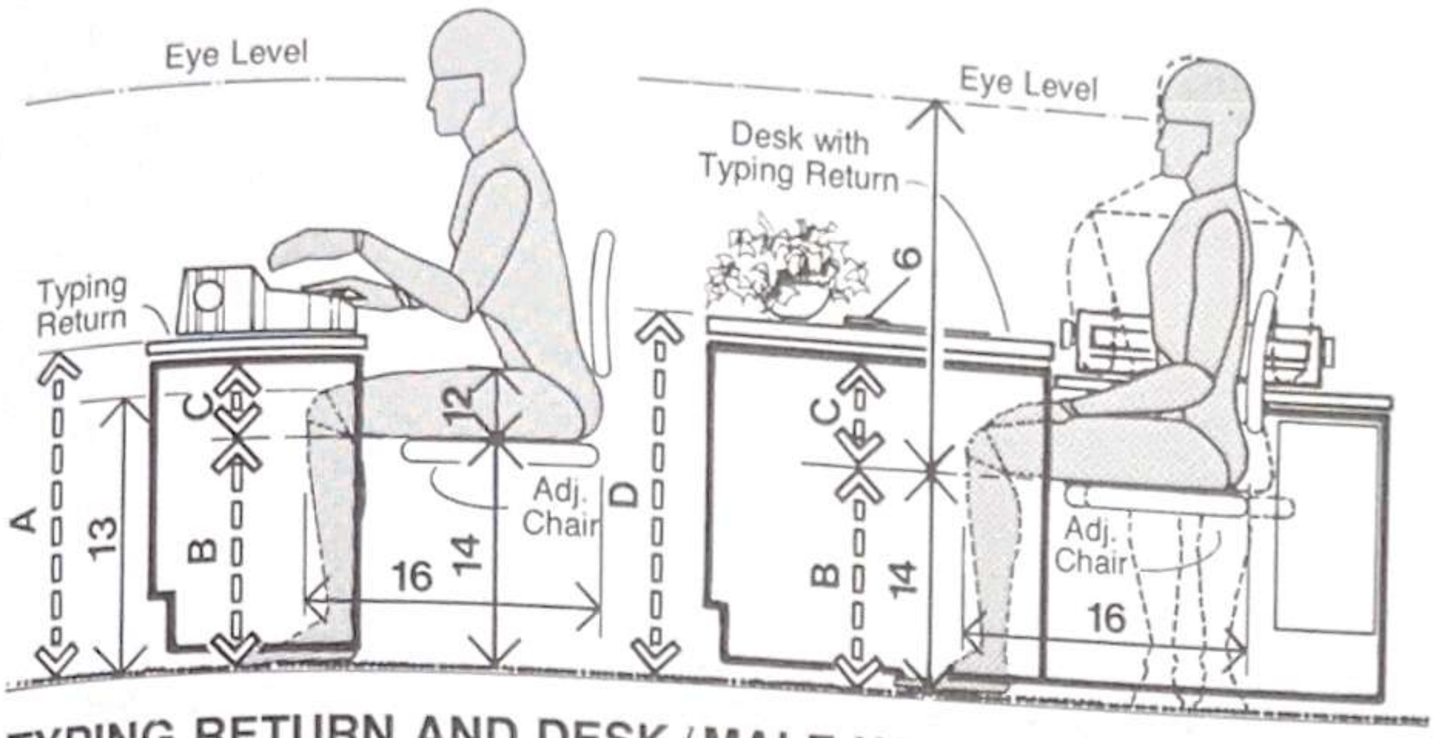


BASIC WORKSTATION WITH VISITOR SEATING

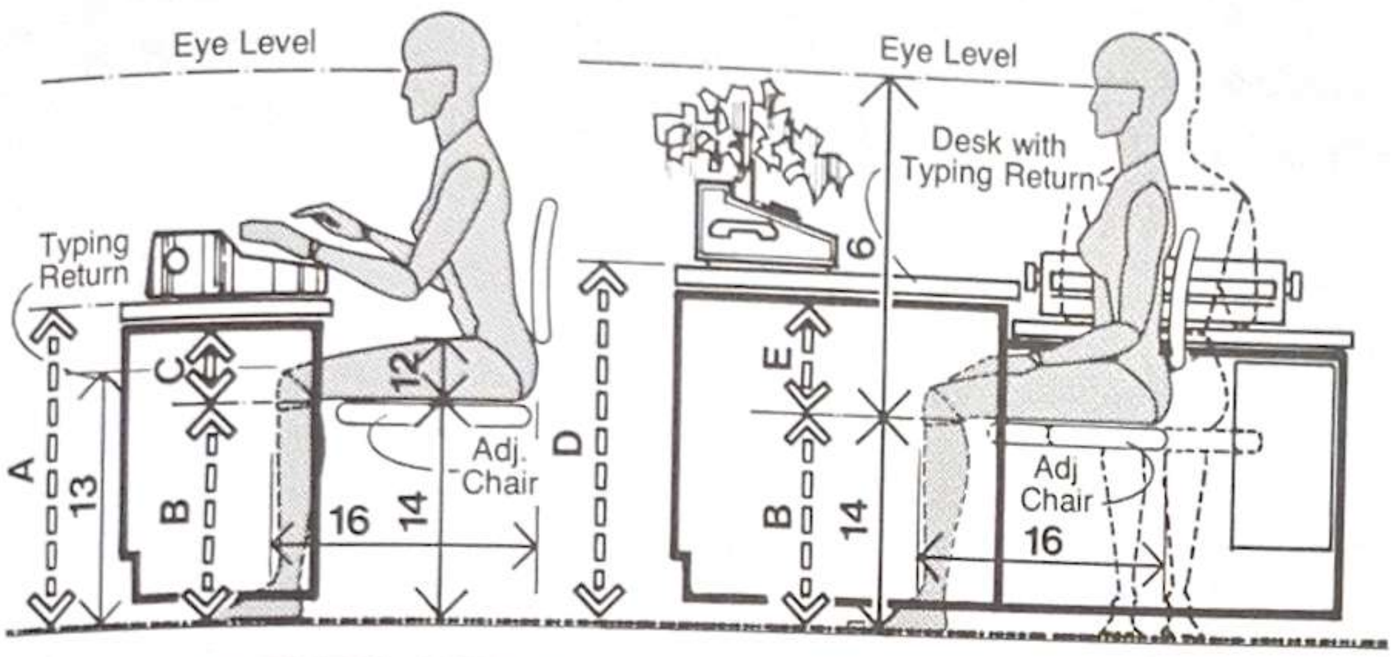
	in	cm
A	90–126	228.6–320.0
B	30–36	76.2–91.4
C	30–48	76.2–121.9
D	6–12	15.2–30.5
E	60–72	152.4–182.9
F	30–42	76.2–106.7
G	14–18	35.6–45.7
H	16–20	40.6–50.8
I	18–22	45.7–55.9
J	18–24	45.7–61.0
K	6–24	15.2–61.0
L	60–84	152.4–213.4
M	24–30	61.0–76.2
N	29–30	73.7–76.2
O	15–18	38.1–45.7



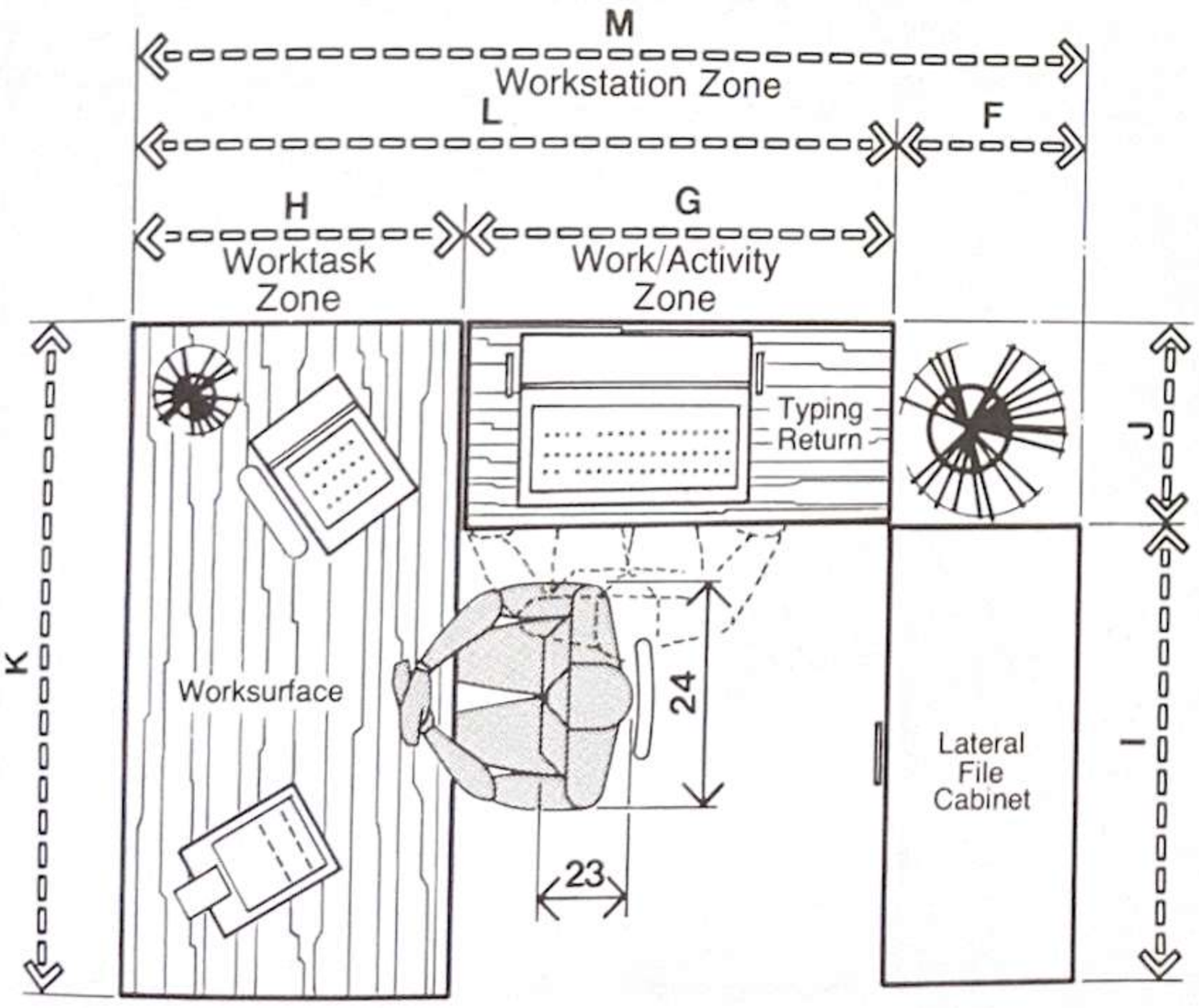
BASIC WORKSTATION WITH VISITOR SEATING



TYPING RETURN AND DESK / MALE USER



TYPING RETURN AND DESK / FEMALE USER



BASIC U-SHAPED WORKSTATION

3.2 THE GENERAL OFFICE

The two elevations at the top illustrate the major anthropometric considerations for the seated male and female user at both workstation and typing return. What should be noted is the seat height of the chair (a function of popliteal height) and its relationship to the specific task. When the worksurface is lowered to accommodate a specialized function, as in the case of the typing return, special attention must be given to the requirements for thigh clearance. Most standard office typing returns have been geared to the anthropometric requirements of the female user. The popliteal height and thigh clearance requirements of the larger male user may not be readily met.

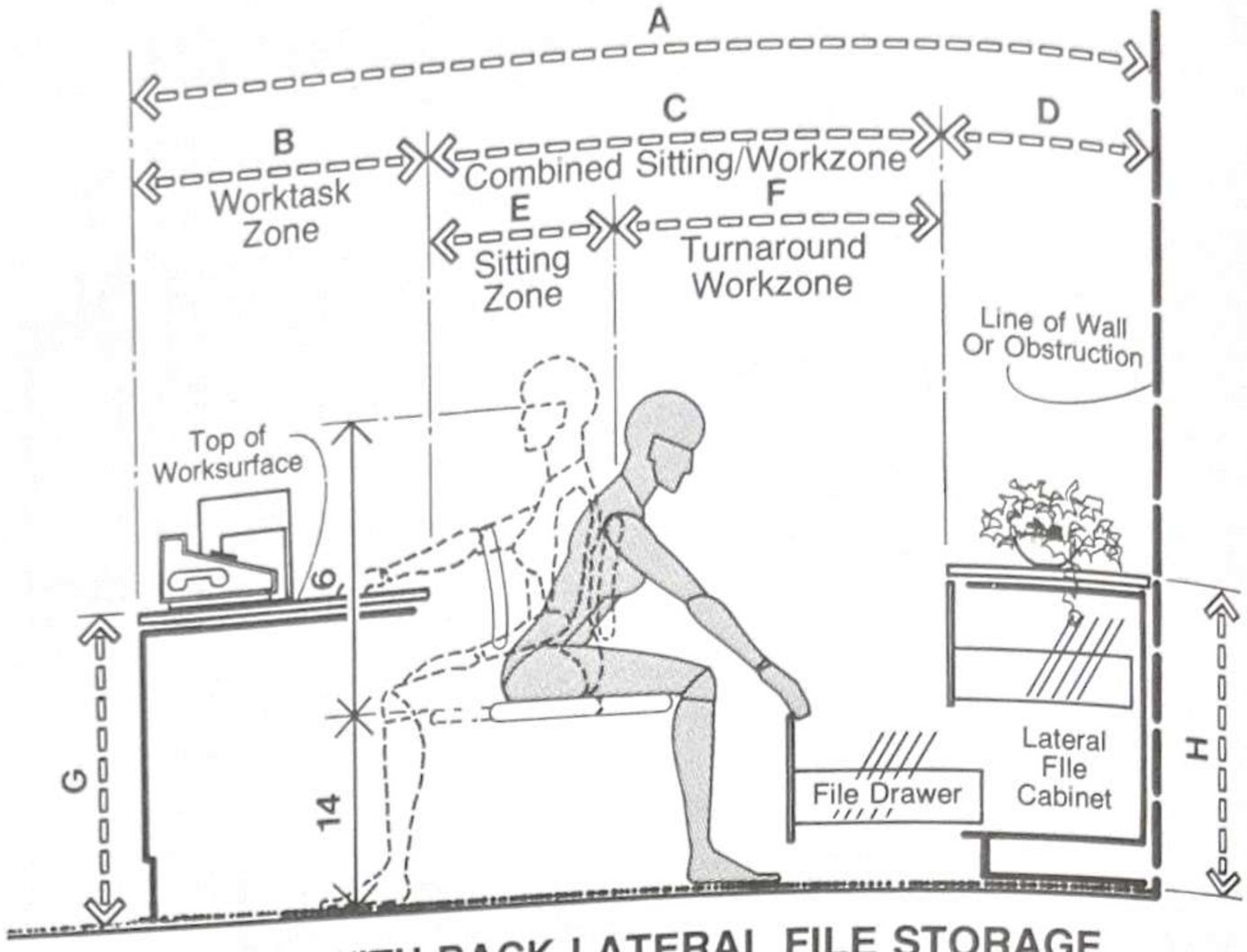
The plan at the bottom shows the typical workstation expanded into the basic U-shaped configuration. The work/activity zone dimension range is shown as 46 to 58 in, or 116.8 to 147.3 cm; additional space is needed to allow for drawer extension of the lateral file. Not only does it provide more storage, the lateral file unit is generally the same height as that of the worksurface and is often utilized as a supplementary worksurface. The distance between this unit and that of the primary worksurface must be sufficient to allow for movement and rotation of the chair.

	in	cm
A	26–27	66.0–68.6
B	14–20	35.6–50.8
C	7.5 min.	19.1 min
D	29–30	73.7–76.2
E	7 min.	17.8 min.
F	18–24	45.7–61.0
G	46–58	116.8–147.3
H	30–36	76.2–91.4
I	42–50	106.7–127.0
J	18–22	45.7–55.9
K	60–72	152.4–182.9
L	76–94	193.0–238.8
M	94–118	238.8–299.7

3.2 THE GENERAL OFFICE

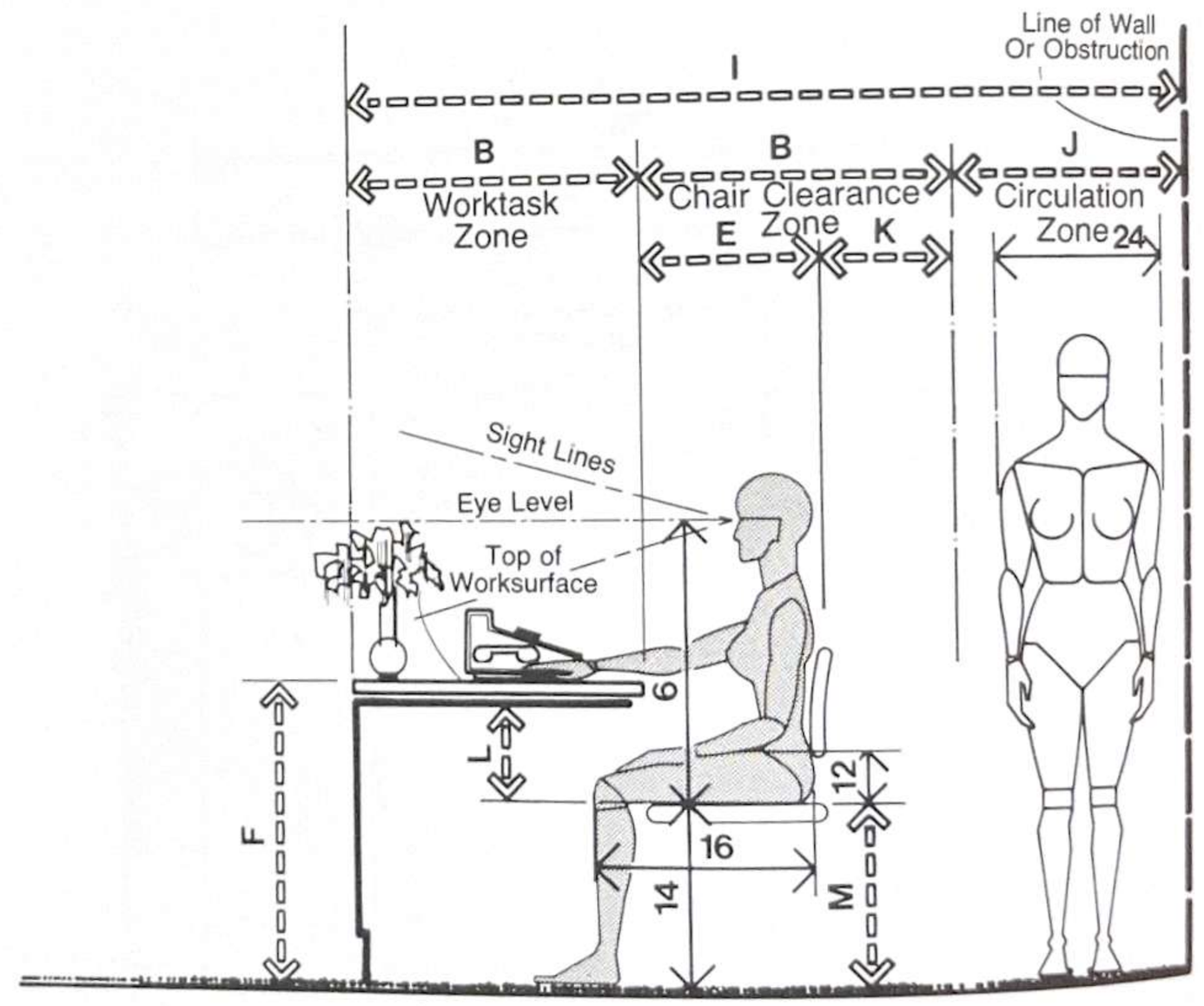
The combined sitting/work zone shown at the top of the page permits the male or female user to rotate 180° for ease of access to a lateral file drawer in the rear. If the minimum clearance shown is not met, access to the file drawer is inhibited, and more awkward body motions or positions for file access are required. A minimum overall dimension to accommodate such a workstation should not be less than 96 in, or 238.8 cm.

In addition to providing appropriate clearance for seat rotation and access to files, it is important to consider the circulation zone requirement for passage behind the seat at the typical workstation. The edge of this zone should take into account the movement of the chair within the chair clearance zone to avoid obstruction of any people circulating behind it. Minimal recommended clearance to allow for that circulation is predicated upon the maximum clothed body breadth of the larger user. Accordingly, this minimum dimension, allowing for the circulation of only one person, should not be less than 30 in, or 76.2 cm. Based upon this minimum dimension and allowing for the requirements of the worktask and chair clearance zones, the overall distance from the front of the worksurface to the line of wall or obstruction should fall between 94 and 114 in, or 238.8 and 289.6 cm.

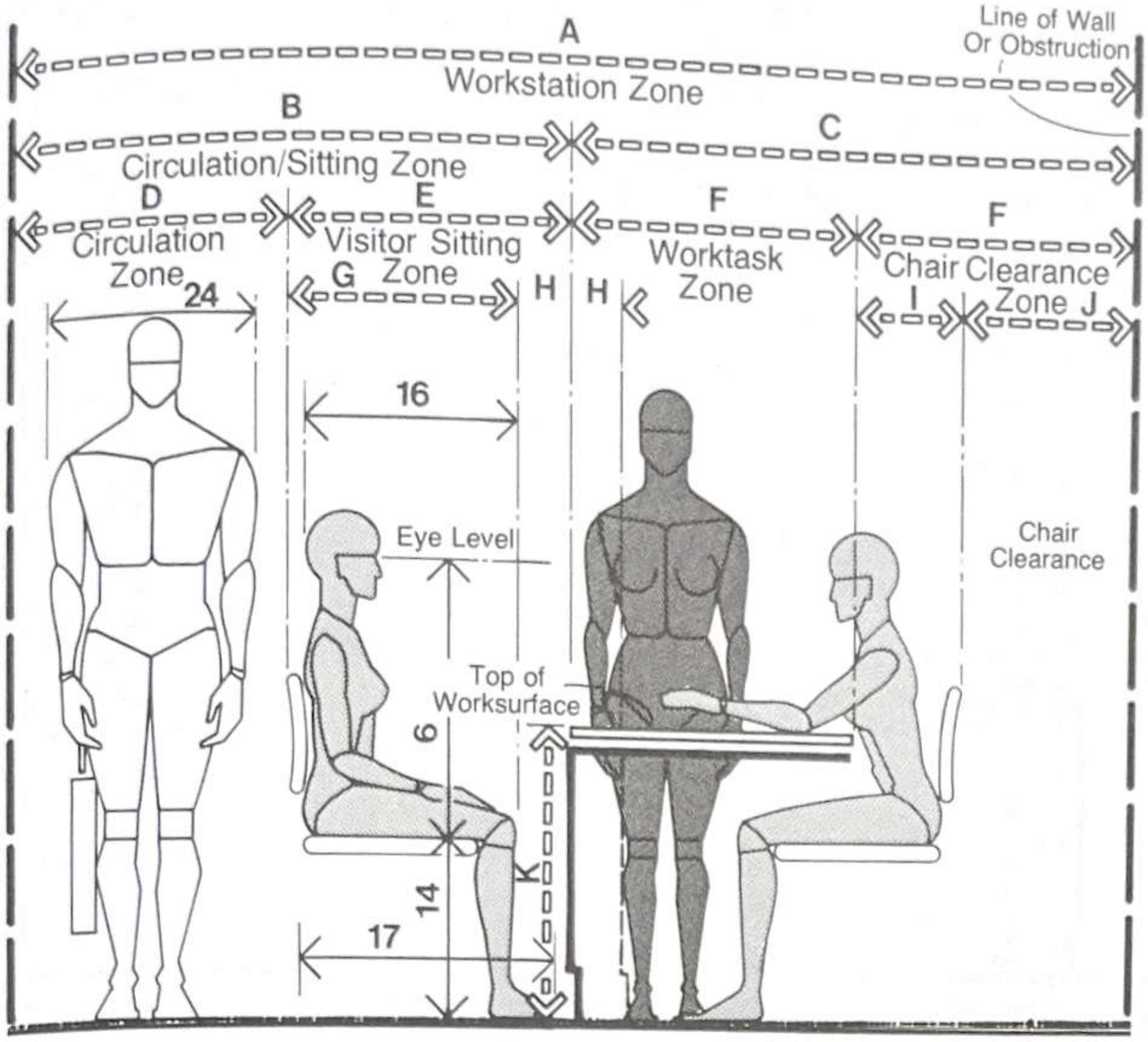


WORKSTATION WITH BACK LATERAL FILE STORAGE

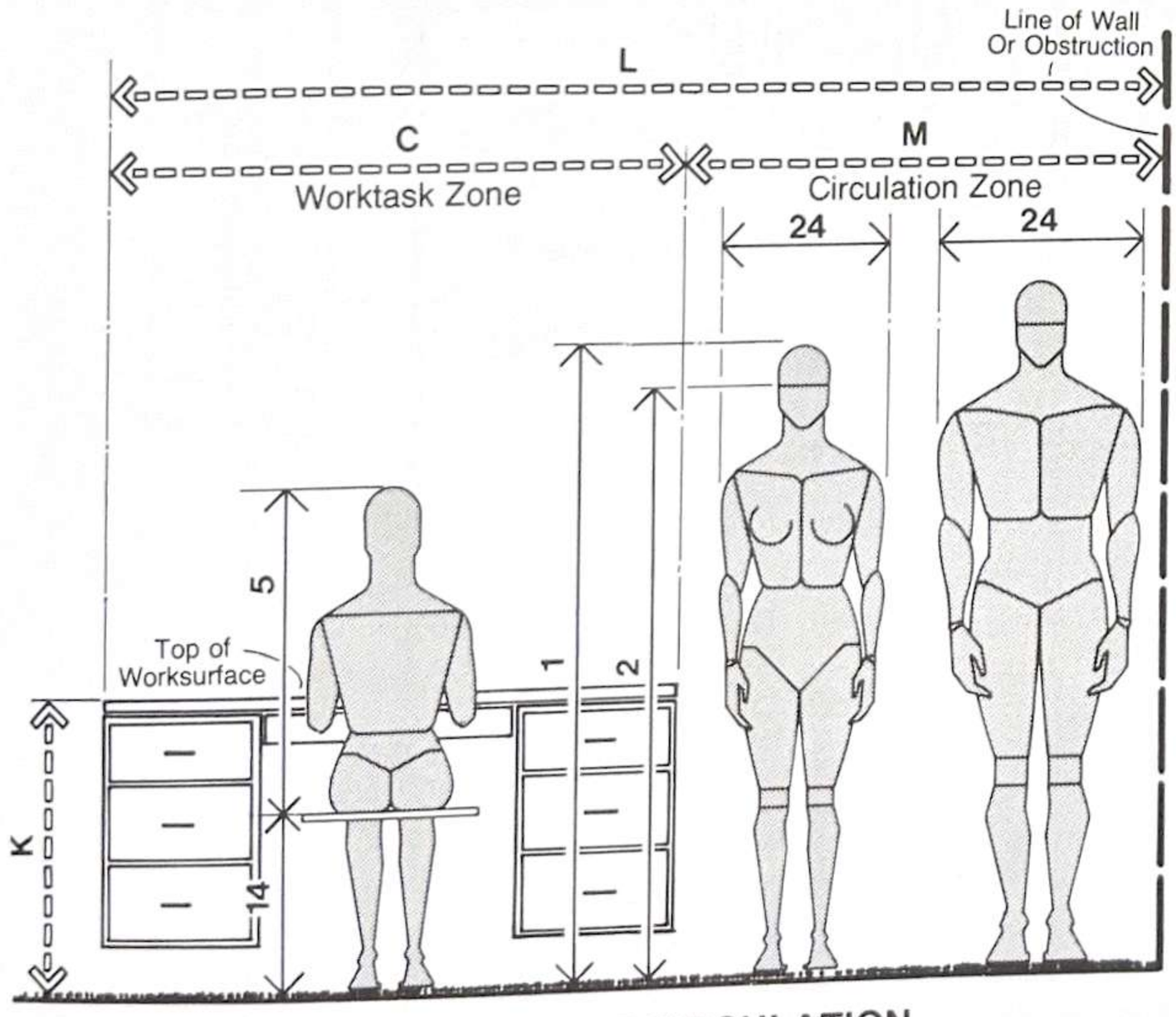
	in	cm
A	96–128	243.8–325.1
B	30–36	76.2–91.4
C	48–68	121.9–172.7
D	18–22	45.7–55.8
E	18–24	45.7–61.0
F	30–44	76.2–111.8
G	29–30	73.7–76.2
H	28–30	71.1–76.2
I	90–102	228.6–259.1
J	30	76.2
K	12	30.5
L	7.5 min.	19.1 min.
M	15–18	38.1–45.7



BASIC WORKSTATION WITH CIRCULATION BEHIND



BASIC WORKSTATION WITH VISITOR SEATING AND CIRCULATION



WORKSTATION AND ADJACENT CIRCULATION

3.2 THE GENERAL OFFICE

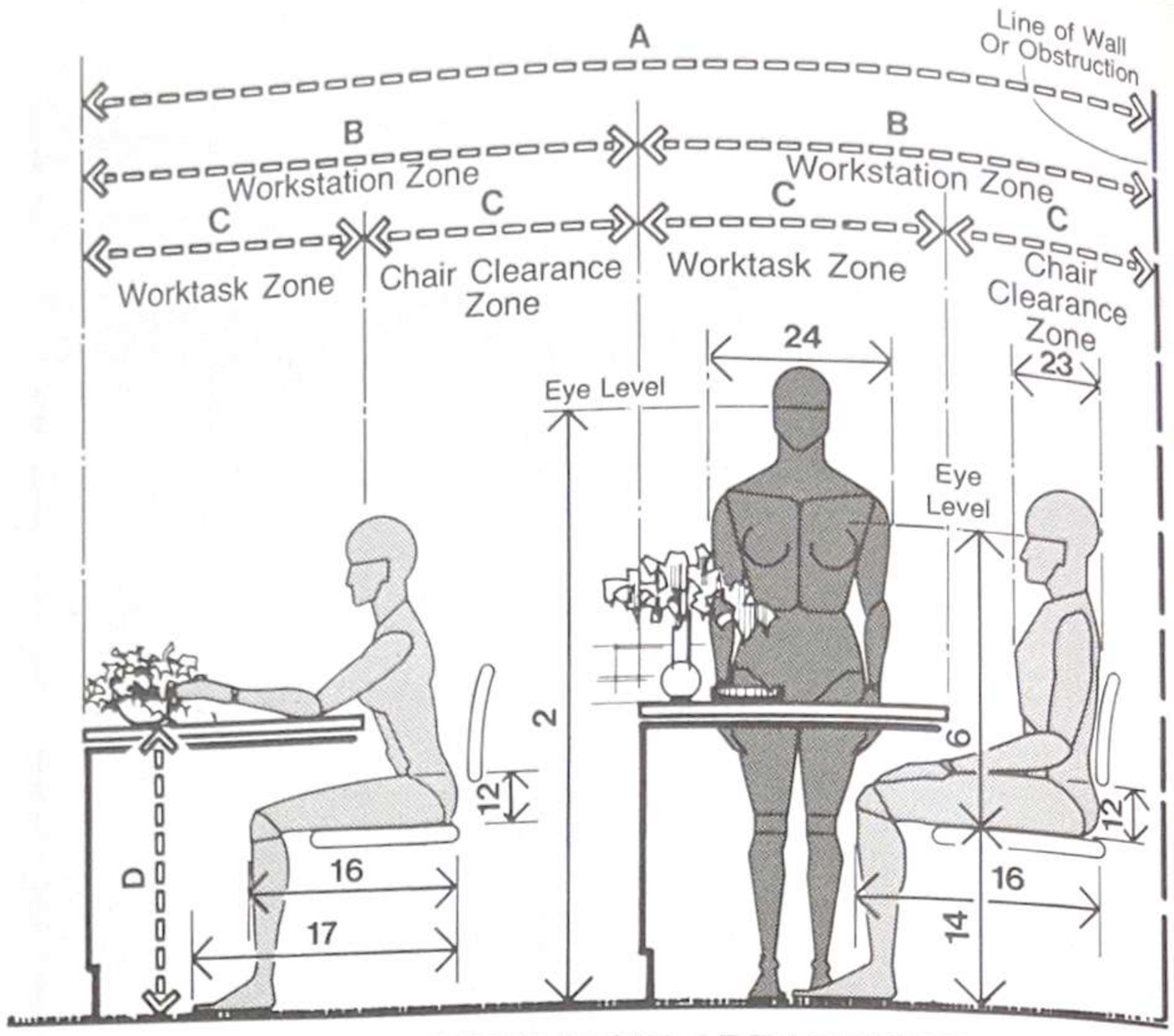
Anthropometrically, the circulation zone and the visitor seating zone must accommodate both maximum body breadth and buttock-toe length measurements of the larger person. Note that in the illustration shown, the visitor seating zone is within an initial range of 24 to 30 in, or 61 to 76.2 cm. Allowing additional clearance from knee to edge of workstation of 6 to 12 in, or 15.2 to 30.4 cm, an overall visitor seating zone ranges from 30 to 42 in, or 76.2 to 106.7 cm. This assumes that the individual in the visitor's chair does not push it back when coming or going, but will stand and then move laterally in the space allocated. It should also be noted that the lack of a desk top overhang does not provide an adequate interface between visitor and desk for close-up conferences. The circulation zone dimension is shown as a minimum of 36 in, or 91.4 cm. In addition to maximum body breadth, the figure in this illustration is shown carrying an attache case in his hand. The attache case is there to suggest that in those circulation zones, where the carrying of objects (documents, trays, files) is required, additional space must be allocated for that function. The elevation at the bottom shows a circulation zone adjacent to the worktask zone that is wide enough to permit clear passage of two people. A minimum dimension of 60 in, or 152.4 cm, is allowed for here, considering once again maximum body breadth constraints.

	in	cm
A	126–150	320.0–381.0
B	66–78	167.6–198.1
C	60–72	152.4–182.9
D	36	91.4
E	30–42	76.2–106.7
F	30–36	76.2–91.4
G	24–30	61.0–76.2
H	6–12	15.2–30.5
I	12–16	30.5–40.6
J	18–20	45.7–50.8
K	29–30	73.7–76.2
L	120–132	304.8–335.3
M	60	152.4

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3.2 THE GENERAL OFFICE

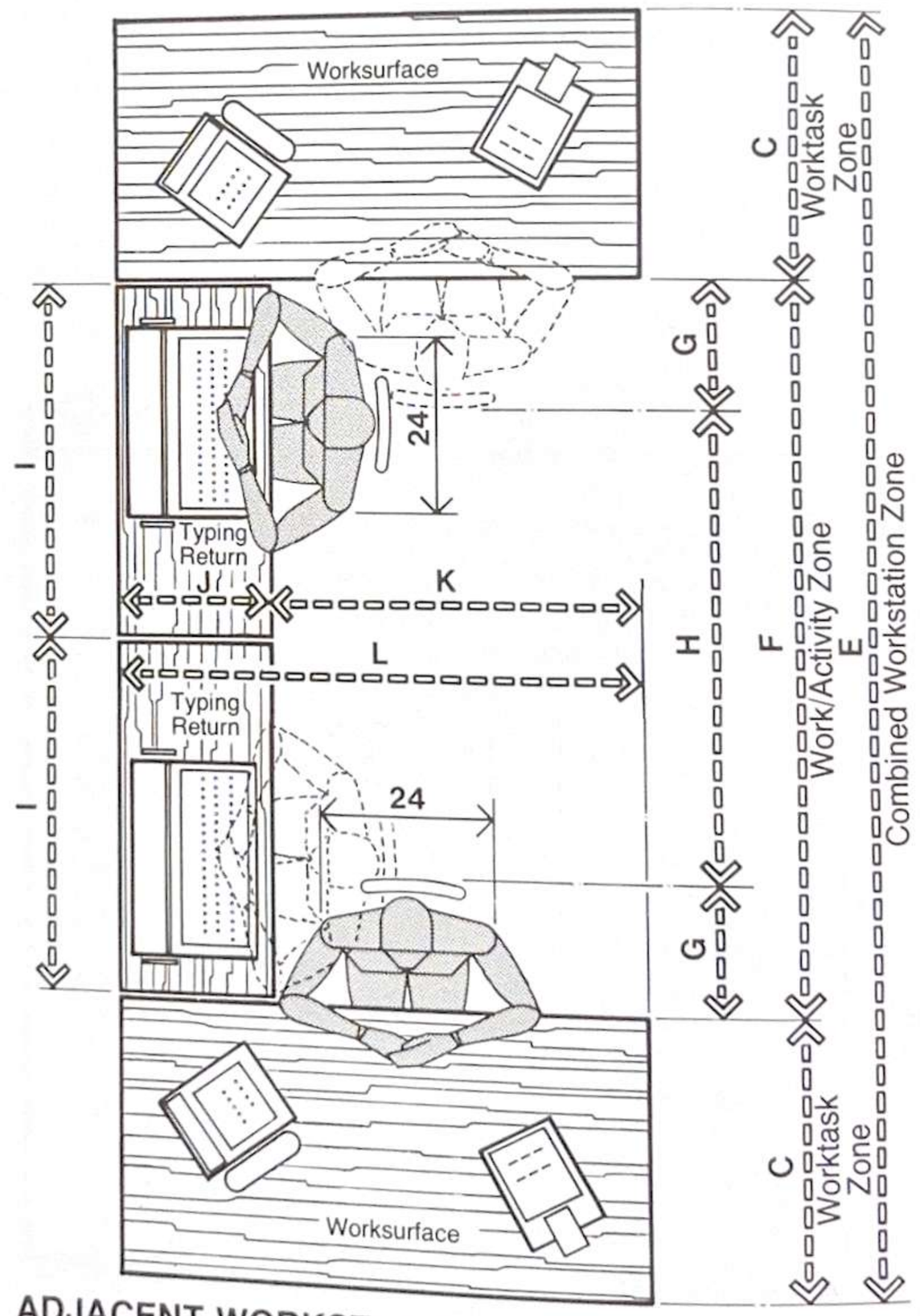
The general office, as it is known today in both conventional and open office planning systems, consists of similar workstations arranged in various configurations. The top drawing shows two such workstations in a typical row arrangement. Basic anthropometric requirements previously established for the individual workstation are used in establishing the dimensions shown. Buttock-knee length and buttock-toe length are the major anthropometric measurements to be considered in establishing the overall dimension shown; they range from 120 to 132 in, or 304.6 to 381 cm. This drawing also involves two other anthropometric measurements: eye height sitting and eye height standing. The importance of these dimensions is addressed later in this section.



ADJACENT WORKSTATIONS / ROW ARRANGEMENT

Grouping the typical workstation in a U-shaped configuration is illustrated in the plan at the bottom of this page. Such a grouping is often used when the people assigned to the paired workstation share common responsibilities or work together on joint tasks or where the sharing of the combined workstation zone results in saving floor space. When such space is shared, the notion of territory is sometimes obscured due to the lack of any clear lines of demarcation. Clearly, the U-shaped configuration, in comparison with the row arrangement at the top, is less restrictive and less confining to the user.

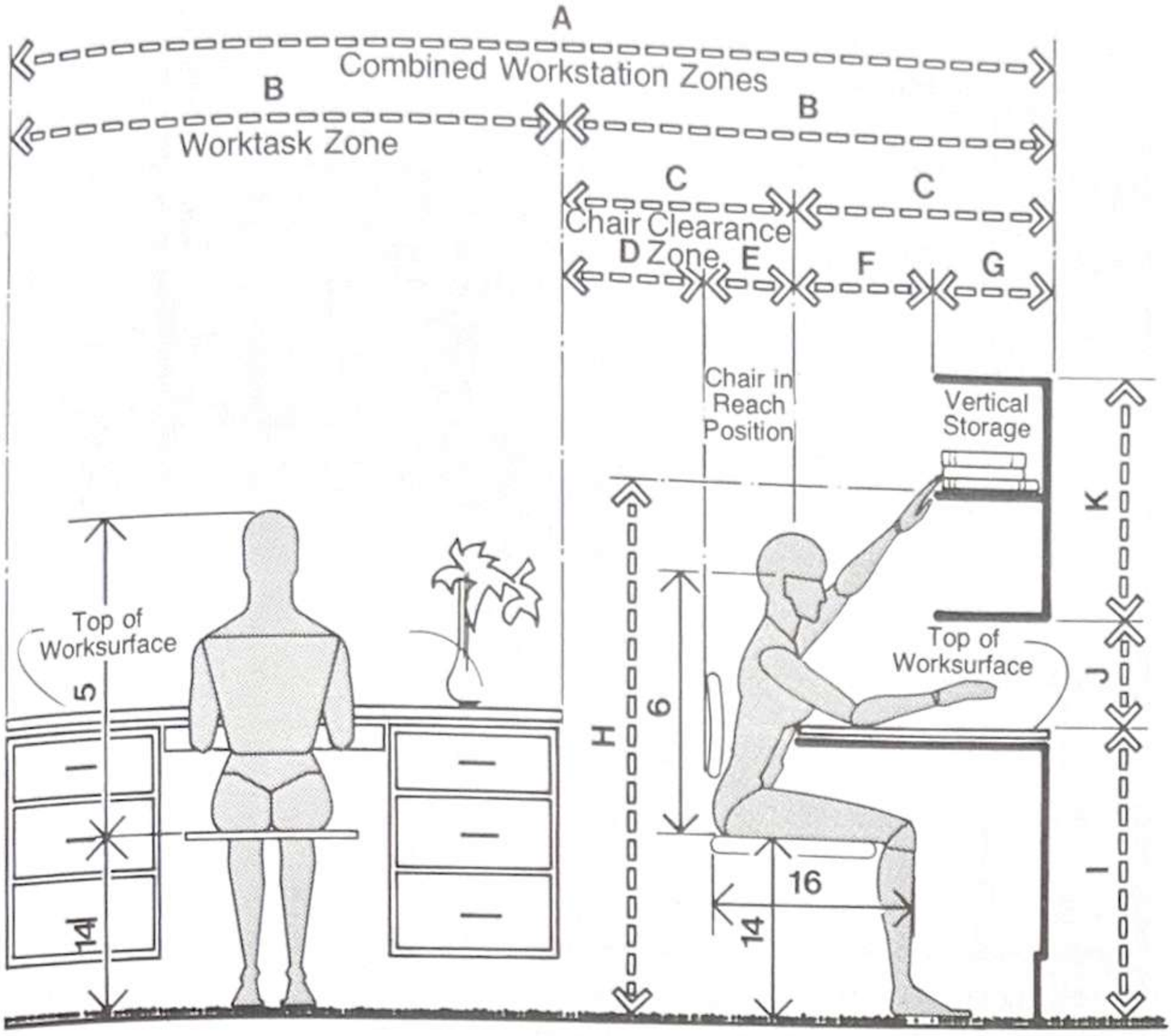
	in	cm
A	120–144	304.8–365.8
B	60–72	152.4–182.9
C	30–36	76.2–91.4
D	29–30	73.7–76.2
E	120–168	304.8–426.7
F	60–96	152.4–243.8
G	18–24	45.7–61.0
H	24–48	61.0–121.9
I	30–48	76.2–121.9
J	18–22	45.7–55.9
K	42–50	106.7–127.0
L	60–72	152.4–182.9



ADJACENT WORKSTATIONS/U-SHAPE

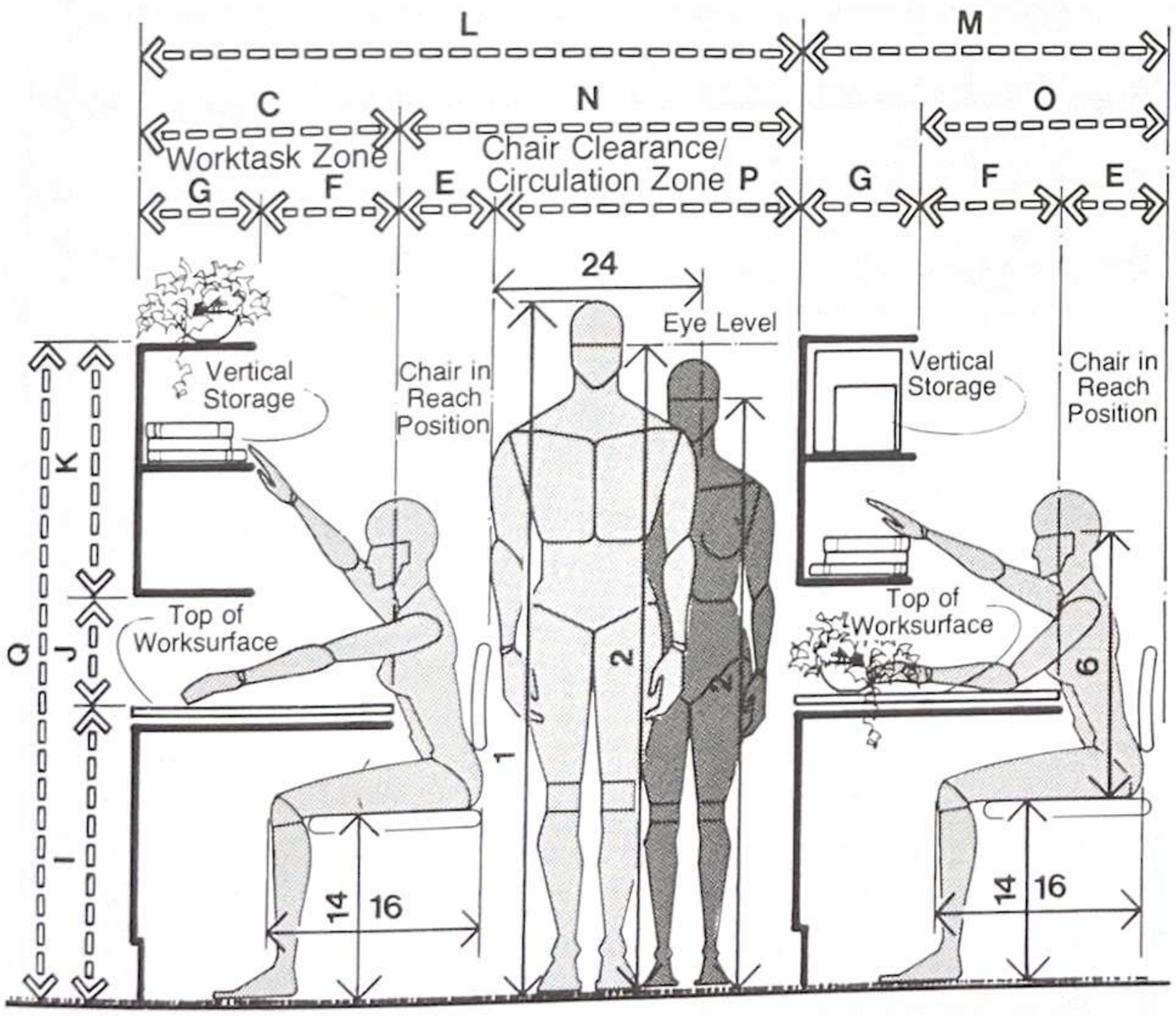
3.2 THE GENERAL OFFICE

With office space becoming more expensive to construct and lease, it has become necessary for designers of the office environment to develop ways in which to utilize space more efficiently. The illustrations on this page focus on vertical storage over the horizontal worksurface plane.



BASIC WORKSTATION WITH VERTICAL STORAGE

The drawing at the top shows the basic workstation with storage located above the top of the worksurface. With the chair placed in the reach position for the user, the height of the upper shelf above the floor should fall between 53 and 58 in, or 134.6 and 147.3 cm. The vertical storage unit above the plane of the horizontal worksurface serves an additional purpose, as demonstrated by the bottom drawing. At the height shown on this drawing, the 95th percentile eye height standing is approximately the same elevation as that of the storage element. The subdivision of space, thereby providing some degree of visual privacy, is accomplished without constructing more permanent floor-to-ceiling partitions.



BASIC WORKSTATIONS BACK TO BACK WITH VERTICAL STORAGE

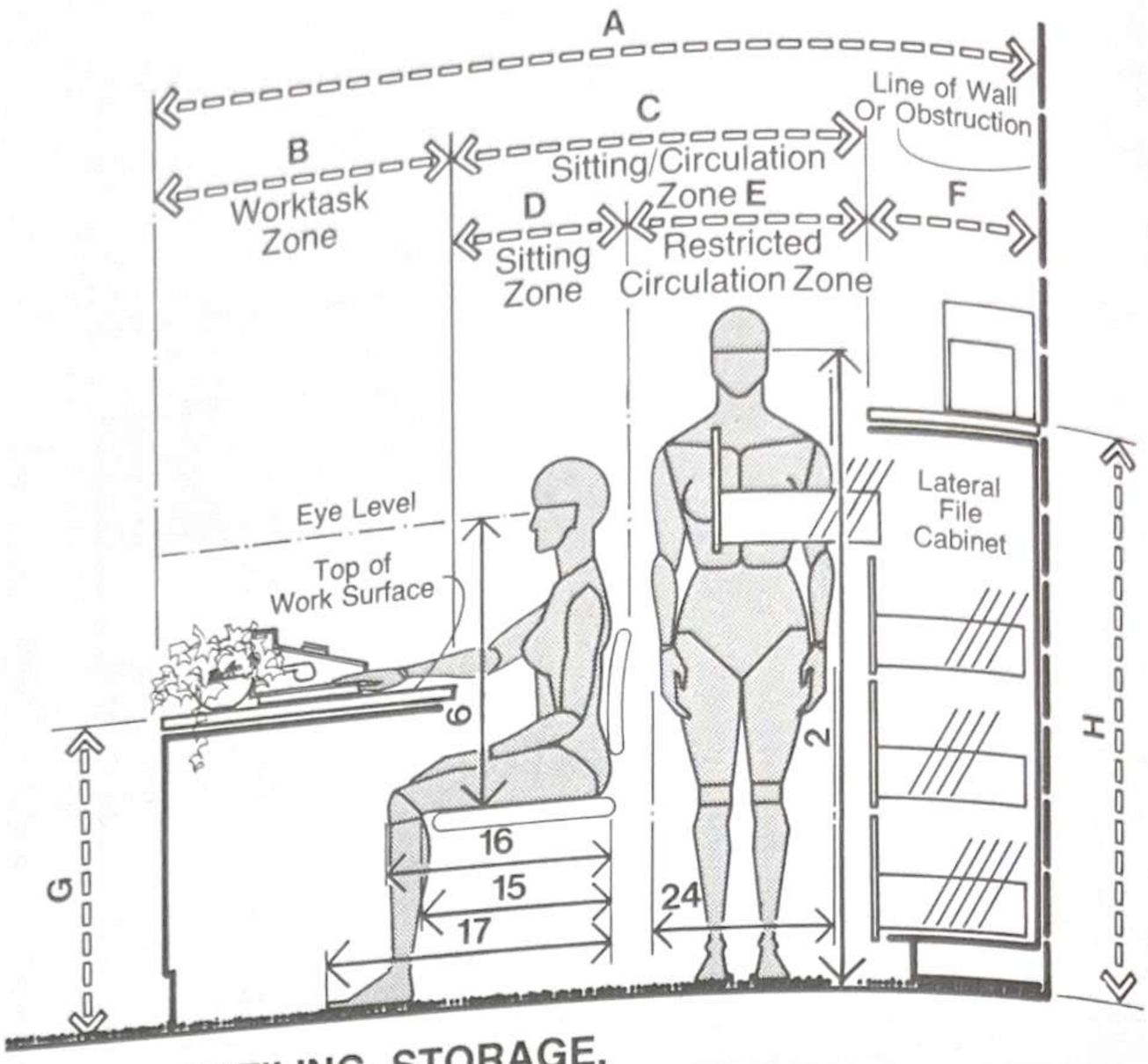
	in	cm
A	120–144	304.8–365.8
B	60–72	152.4–182.9
C	30–36	76.2–91.4
D	18–20	45.7–50.8
E	12–16	30.5–40.6
F	18–24	45.7–61.0
G	12	30.5
H	53–58	134.6–147.3
I	29–30	73.7–76.2
J	15 min.	38.1 min.
K	25–31	63.5–78.7
L	78–94	198.1–258.8
M	42–52	106.7–132.1
N	48–58	121.9–147.3
O	30–40	76.2–101.6
P	36–42	91.4–106.7
Q	69–76	175.3–193.0

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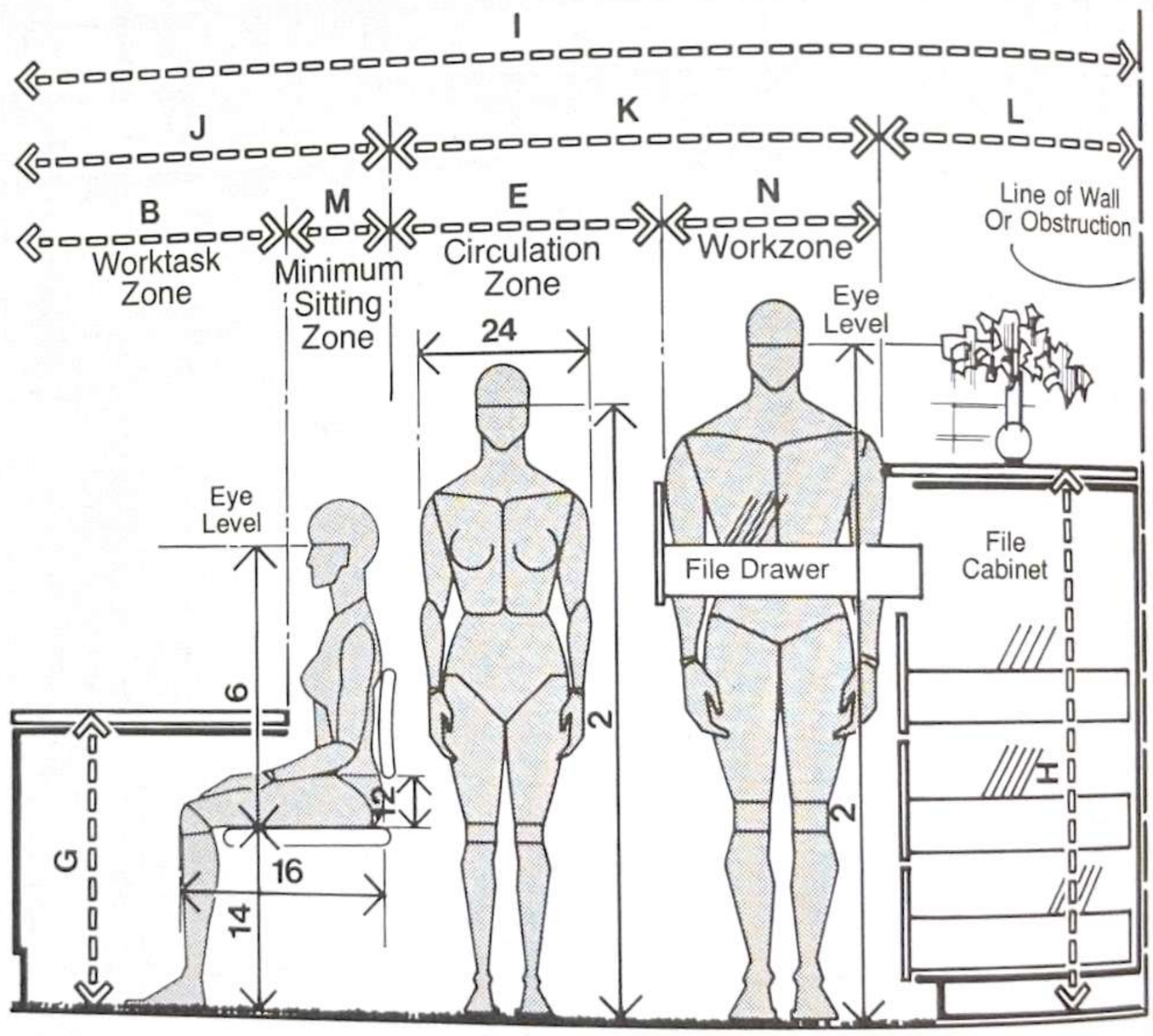
3.2 THE GENERAL OFFICE

A typical situation that occurs in planning the general office is the relationship of the basic desk or workstation to filing and storage. The drawing at the top of the page shows a sitting zone of 18 to 24 in, or 45.7 to 61 cm. Reflected within this range are buttock-knee length and buttock-toe length measurements. Circulation behind the desk is obstructed when the drawer of the lateral file cabinet is in an extended position. When the file drawer is in the closed position, a 30-in, or 76.2-cm, circulation zone is provided.

The drawing shown on the bottom of the page demonstrates the relationship of the workstation with a circulation zone behind it, as well as an allowance for full extension of the file drawer. The distance the extended file drawer projects is a function of the type of file storage unit. An overall dimension range of 48 and 56 in, or 121.9 and 142.2 cm, is provided to accommodate a circulation zone and the file drawer in its extended position. It should be noted, however, that if constant access to the file cabinets is necessary, the circulation zone will be violated, in which case a different plan arrangement should be considered.

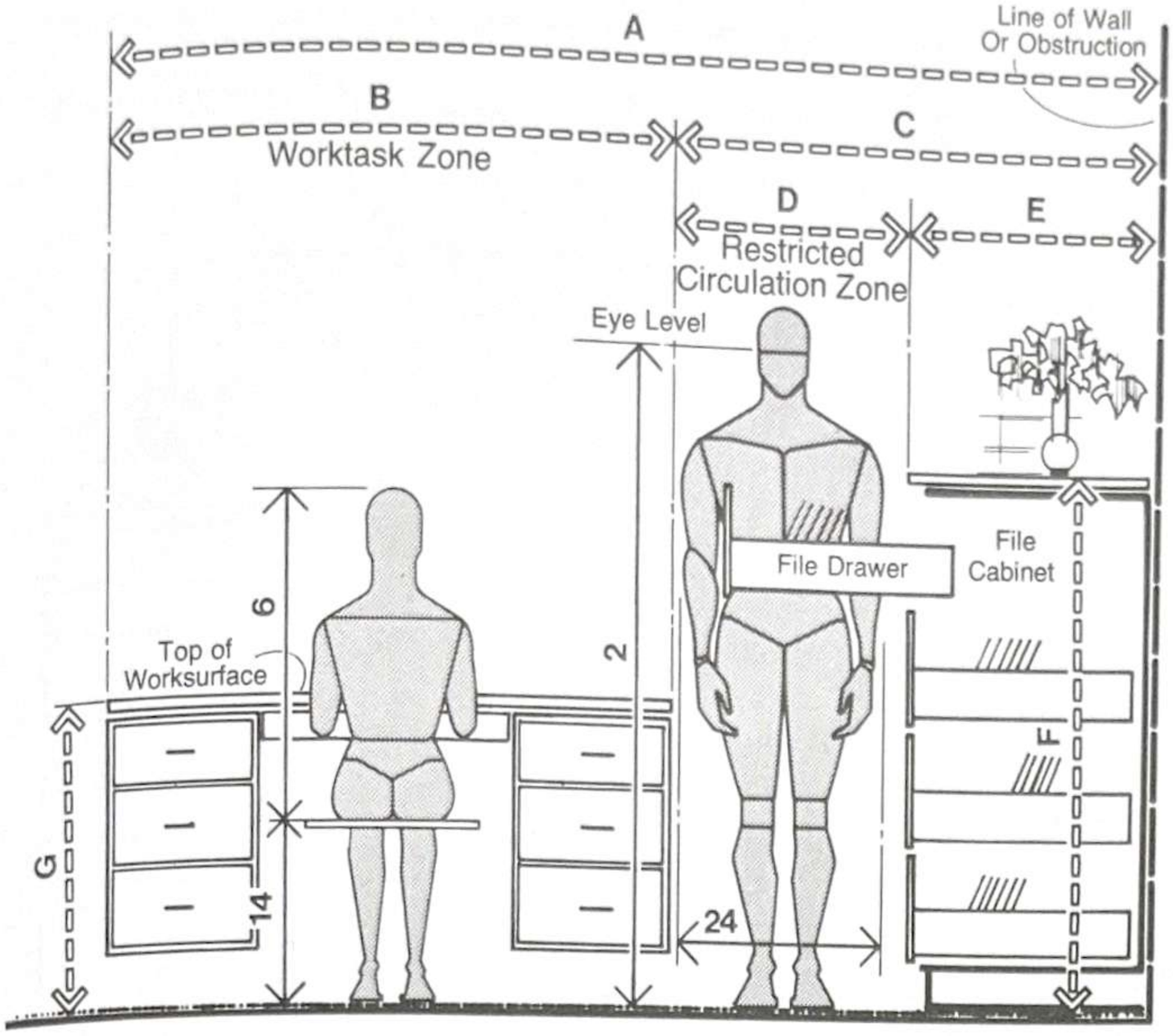


DESK WITH FILING, STORAGE, AND RESTRICTED CIRCULATION

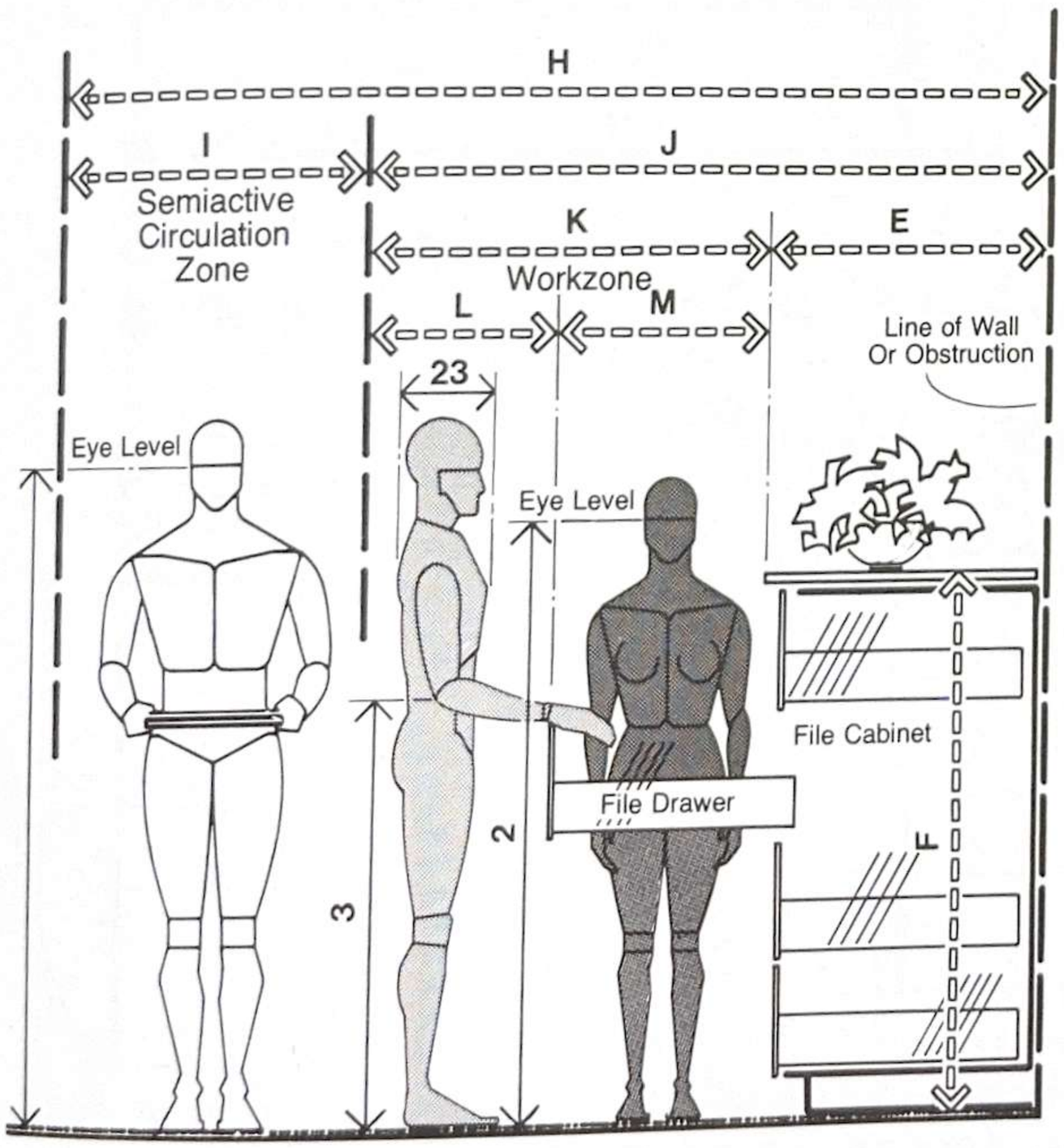


DESK WITH FILING AND STORAGE

	in	cm
A	96–112	243.8–284.5
B	30–36	76.2–91.4
C	48–54	121.9–137.2
D	18–24	45.7–61.0
E	30	76.2
F	18–22	45.7–55.9
G	29–30	73.7–76.2
H	54–58	137.2–147.3
I	110–136	279.4–345.4
J	42–52	106.7–132.1
K	48–56	121.9–142.2
L	20–28	50.8–71.1
M	12–16	30.5–40.6
N	18–26	45.7–66.0



WORKSTATION WITH FILING AND STORAGE



FILING/ACCESS CLEARANCES

	in	cm
A	110–130	279.4–330.2
B	60–72	152.4–182.9
C	50–58	127.0–147.3
D	30	76.2
E	20–28	50.8–71.1
F	54–58	137.2–147.3
G	29–30	73.7–76.2
H	92–108	233.7–274.3
I	36	91.4
J	56–72	142.2–182.9
K	36–44	91.4–111.8
L	18	45.7
M	18–26	45.7–66.0

3.2 THE GENERAL OFFICE

As the drawing at the top clearly demonstrates, an obstructed circulation zone results if appropriate consideration is not given to the extension of the file drawer. Such a situation must be avoided at all costs, unless the file cabinet in question is clearly used for dead files or the circulation zone is one of limited usage. The drawing at bottom, however, shows proper filing and access clearances. Access to the extended drawer has been provided both from the side and from the front. The work zone, specifically provided for filing, accommodates the anthropometric dimension of body depth, in addition to allowing for the extended file drawer. Immediately contiguous to the file work zone is a semiactive circulation zone of 36 in, or 91.4 cm, based upon maximum body breadth of the larger person. A 36-in, or 91.4-cm, dimension should be utilized instead of 30 in, or 76.2 cm, if the person using that path of circulation is also carrying files, folders, and so forth.

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