

Using the Snook Push/Pull Tables

The Hazard Analysis Tool generally called the "Snook Tables" was developed at Liberty Mutual Insurance Company and is described in Snook, S. H. and Ciriello, V. M., "The design of manual handling tasks: revised tables of maximum acceptable weights and forces", *Ergonomics*, 34,9,1991. These tables are based on controlled experiments using psychophysical evaluation, and can be used to find the percent of an industrial population capable of sustaining the efforts tabulated in lifting, lowering, pushing, pulling, and carrying. Accordingly, they are of more general use than the Revised NIOSH Lifting Equation because they apply to a broader variety of tasks, but less precise because they are based on psychophysical measures rather than biomechanical. This is less a disadvantage than a guide to use. While the NIOSH equation establishes a recommended weight limit for lifting, the Snook tables provide guidance as to the proportion of the population that should be able to do the tasks as a regular part of daily work. Both are intended to assist in control of low back pain. The guidelines below are intended to assist in use of the tables in analysis of hazards that might exist in jobs involving lifting, lowering, pushing, pulling and carrying.

Lifting and lowering tables:

- Select width of object (outward from body) in the tables closest to that encountered in the task
- Select closest distance of lift
- Select lifting zone (floor to knuckle, knuckle to shoulder, shoulder to arm reach)
- Select gender of worker
- Find closest weight in table corresponding to width, distance, zone, gender, and repetition
- Find the corresponding percent of population who can perform this task without stress

Push and pull tables:

- Select height of application of force (floor to hands)
- Select push or pull distance
- Find closest force in table corresponding to height, distance, gender and repetition; note that both initial force and sustained force may be limiting
- Find the corresponding percent of population who can perform this task without stress

Carry tables:

- Select height of grip (floor to hands)
- Select carry distance
- Find closest weight in table corresponding to height, distance, gender and repetition
- Find the corresponding percent of population who can perform this task without stress

Application considerations:

- When lifting, lowering or carrying boxes without handles, reduce weights by 15%
- When lifting or lowering with extended reach in knee to shoulder zone, reduce weights by 50%
- Tables apply to single tasks; when used with multiple tasks (combination of lifting, lowering, push/pull and/or carrying), the authors of the tables recommend use of the weight or force corresponding to the smallest population percent for the tasks combined. Some combined tasks may exceed recommended physiological limits for an eight hour shift.
- Some weights may exceed recommended physiological limits during an 8 hour shift, as noted by italics in the tables.
- For weights and forces between table entries, a conservative approach would use the higher weight or force.
- It may be helpful to review the tables before starting the analysis

Maximum Acceptable Weight of Lift for Males (kg)

Width	Distance	Percent	Floor level to knuckle height							Knuckle height to shoulder height							Shoulder height to arm reach												
			One lift every							One lift every							One lift every												
			5	9	14	1	2	5	30	8	5	9	14	1	2	5	30	8	5	9	14	1	2	5	30	8			
			s			min			h			s			min			h			s			min			h		
76	90	6	7	9	11	13	14	14	17	8	10	12	13	14	14	16	17	6	8	9	10	10	11	12	13				
	75	9	11	13	16	19	20	21	24	10	14	16	18	18	19	21	23	8	10	12	14	14	14	16	17				
	50	12	15	17	22	25	27	28	32	13	17	20	22	23	24	26	29	10	13	15	17	17	18	20	22				
	25	15	18	21	28	31	34	35	41	16	21	24	27	27	28	32	35	11	16	18	21	21	22	24	27				
75	90	6	8	9	12	13	15	15	17	8	11	13	15	15	16	18	19	6	8	9	12	12	12	14	15				
	75	9	11	13	17	19	21	22	25	11	15	17	20	20	21	23	25	8	11	12	15	15	16	18	20				
	50	13	15	18	23	26	28	29	34	14	19	21	25	25	26	29	32	10	14	16	19	20	20	23	25				
	25	16	19	22	29	33	35	36	42	17	23	26	30	31	32	36	39	13	17	19	23	24	25	27	30				
25	90	8	9	11	13	15	16	17	20	10	13	15	18	18	19	21	23	7	10	11	14	14	14	16	18				
	75	11	13	15	19	22	24	24	28	13	17	20	23	24	25	27	30	10	13	15	18	18	19	21	23				
	50	15	18	21	26	29	32	33	38	17	22	25	30	30	31	35	38	12	16	19	23	23	24	27	29				
	25	18	22	26	33	37	40	41	48	20	27	30	36	36	38	42	46	15	20	22	28	28	29	32	35				
76	90	7	8	10	13	15	16	17	20	8	10	12	13	14	14	16	17	7	9	10	12	12	13	14	16				
	75	10	12	14	19	22	24	24	28	10	14	16	18	18	19	21	23	9	11	13	16	16	17	19	21				
	50	14	16	19	26	29	32	33	38	13	17	20	22	23	24	26	29	11	15	17	20	21	21	24	26				
	25	17	20	24	33	37	40	41	48	16	21	24	27	27	28	32	35	13	18	20	25	25	26	29	31				
49	90	7	9	10	14	16	17	18	20	8	11	13	15	15	16	18	19	7	9	11	14	14	14	16	18				
	75	10	13	15	20	23	25	25	30	11	15	17	20	20	21	23	25	9	12	14	18	18	19	21	23				
	50	14	17	20	27	30	33	34	40	14	19	21	25	25	26	29	32	12	15	18	23	23	24	27	29				
	25	18	21	25	34	38	42	43	50	17	23	26	30	31	32	36	39	14	19	21	28	28	29	32	35				
25	90	8	10	12	16	18	19	20	23	10	13	15	18	18	19	21	23	9	11	12	16	16	17	19	21				
	75	12	15	17	23	26	28	29	33	13	17	20	23	24	25	27	30	11	14	16	21	21	22	25	27				
	50	16	20	23	30	34	37	38	45	17	22	25	30	30	31	35	38	14	18	21	27	27	28	32	35				
	25	21	25	29	38	43	47	48	56	20	27	30	36	36	38	42	46	16	22	25	33	33	34	38	42				
76	90	8	10	11	15	17	19	19	23	8	11	13	15	15	16	18	19	8	10	12	14	14	15	16	18				
	75	12	14	17	22	25	28	28	33	11	15	17	20	20	21	23	25	10	14	16	18	19	19	24	24				
	50	16	19	22	30	34	37	38	44	14	19	21	25	25	26	29	32	13	17	20	23	24	25	27	30				
	25	20	24	28	37	42	47	47	55	17	23	26	30	31	32	36	39	16	21	24	28	29	30	33	36				
34	90	9	10	12	16	18	20	20	24	9	12	14	17	17	18	20	22	8	11	13	16	16	17	18	20				
	75	12	15	18	23	26	28	29	34	12	16	18	22	23	23	26	29	11	14	17	21	21	22	24	26				
	50	17	20	24	31	35	38	39	46	15	20	23	28	29	30	33	36	14	18	21	26	27	28	31	34				
	25	21	25	30	39	44	48	49	57	18	24	27	34	35	36	40	44	17	22	25	32	32	33	37	41				
25	90	10	12	14	18	20	22	23	27	11	14	16	20	20	21	23	26	10	13	15	19	19	19	22	24				
	75	15	18	21	26	30	32	33	38	14	18	21	26	27	28	31	34	13	17	20	24	25	26	29	31				
	50	20	24	28	35	40	43	44	52	18	23	27	33	34	35	39	43	16	22	25	31	31	33	36	40				
	25	26	30	35	44	50	54	55	65	21	28	32	40	41	42	47	52	20	26	30	37	38	39	44	46				
10	29	35	41	52	59	64	66	76	25	33	37	47	47	49	55	60	23	30	35	43	44	45	51	55					

Note:
 1. Width is dimension away from body in cm
 2. Distance is vertical lift in cm
 3. Percent pertains to industrial population
 4. Italicized values exceed 8 hr physiological criteria

Maximum Acceptable Weight of Lift for Females (kg)

Width	Distance	Percent	Floor level to knuckle height One lift every								Knuckle height to shoulder height One lift every								Shoulder height to arm reach One lift every							
			5	9	14	1	2	5	30	8	5	9	14	1	2	5	30	8	5	9	14	1	2	5	30	8
			s				min				s				min				s				min			
76	90	90	5	6	7	7	8	8	9	12	5	6	7	9	9	9	10	12	4	5	5	6	7	7	7	8
	75	75	7	8	9	9	10	10	11	14	6	7	8	10	11	11	12	14	5	6	6	7	8	8	8	10
	50	50	8	10	10	11	12	12	13	17	7	8	9	11	12	12	13	16	6	7	7	8	9	9	10	11
	25	25	9	11	12	13	14	14	15	21	8	9	10	13	14	14	15	18	7	7	8	9	10	10	11	13
75	90	90	11	13	14	14	15	16	23	9	10	11	14	15	15	17	20	7	8	9	10	11	11	12	14	
	75	75	6	7	8	8	9	9	10	14	6	7	8	9	10	10	11	13	5	6	7	7	7	7	8	9
	50	50	7	9	9	10	11	11	13	17	7	8	9	11	12	12	13	15	6	7	8	8	9	9	9	11
	25	25	9	10	11	12	13	14	15	21	9	9	11	13	14	14	15	17	7	8	9	9	10	10	11	13
25	90	90	10	12	13	15	16	16	24	10	11	12	14	16	16	17	20	8	9	10	10	11	11	12	14	
	75	75	11	14	15	17	18	18	20	27	11	12	14	16	17	17	19	22	9	10	11	12	13	13	14	16
	50	50	6	8	8	9	9	9	11	14	6	7	8	10	11	11	12	14	5	6	7	8	8	8	9	10
	25	25	8	10	11	11	12	12	13	18	7	8	9	12	13	13	14	17	6	7	8	9	9	9	10	12
76	90	90	10	12	13	13	14	14	16	21	9	10	11	14	15	15	16	19	7	8	9	10	11	11	12	14
	75	75	11	14	15	15	16	17	19	25	10	11	12	16	17	17	19	22	8	9	10	12	12	12	14	16
	50	50	13	16	17	17	19	19	21	29	11	12	14	18	19	19	21	24	9	10	11	13	14	14	15	17
	25	25	5	6	7	8	8	8	9	13	5	6	7	9	9	9	10	12	4	5	5	7	7	7	8	9
49	90	90	7	8	9	10	10	10	12	16	6	7	8	10	11	11	12	14	5	6	6	8	8	8	9	11
	75	75	8	10	10	12	12	13	14	19	7	8	9	11	12	12	13	16	6	7	7	9	10	10	11	12
	50	50	9	11	12	14	15	15	17	22	8	9	10	13	14	14	15	18	7	7	8	10	11	11	12	14
	25	25	11	13	14	15	17	17	19	25	9	10	11	14	15	15	17	20	7	8	9	11	12	12	13	15
25	90	90	6	7	8	9	10	10	11	15	6	7	8	9	10	10	11	13	5	6	7	7	8	8	9	10
	75	75	7	9	9	11	12	12	14	18	7	8	9	11	12	12	13	15	6	7	8	9	9	9	10	12
	50	50	9	10	11	13	15	15	16	22	9	9	11	13	14	14	15	17	7	8	9	10	11	11	12	14
	25	25	10	12	13	16	17	17	19	26	10	11	12	14	16	16	17	20	8	9	10	11	12	12	13	15
34	90	90	11	14	15	18	19	20	22	30	11	12	14	16	17	17	19	22	9	10	11	13	14	14	15	17
	75	75	6	8	8	9	10	10	11	15	6	7	8	10	11	11	12	14	5	6	7	8	9	9	10	11
	50	50	8	10	11	12	12	13	14	19	7	8	9	12	13	13	14	17	6	7	8	9	10	10	11	13
	25	25	10	12	13	14	15	15	17	23	9	10	11	14	15	15	16	19	7	8	9	11	12	12	13	15
76	90	90	11	14	15	16	18	18	20	27	10	11	12	16	17	17	19	22	8	9	10	12	13	13	15	17
	75	75	13	16	17	19	20	21	23	31	11	12	14	18	19	19	21	24	9	10	11	14	15	15	16	19
	50	50	7	8	9	9	10	10	11	15	6	7	8	9	10	10	11	13	5	6	7	8	9	9	10	11
	25	25	8	10	11	12	13	13	14	19	7	8	9	11	12	12	13	15	6	7	8	9	10	10	11	13
25	90	90	10	12	13	14	15	16	17	23	9	9	11	13	14	14	15	17	7	8	9	11	12	12	13	15
	75	75	12	14	15	17	18	18	20	27	10	11	12	14	16	16	17	20	8	9	10	12	13	13	15	17
	50	50	13	16	18	19	20	21	23	31	11	12	13	16	17	17	19	22	9	10	11	14	15	15	16	19
	25	25	7	9	9	11	12	12	13	18	8	8	9	10	11	11	12	14	7	7	8	9	10	10	11	12
25	90	90	9	11	12	14	15	15	16	22	9	10	11	12	13	13	14	17	8	8	9	11	11	11	12	14
	75	75	11	13	14	16	18	18	20	27	10	11	13	14	15	15	17	19	9	10	11	12	13	13	14	17
	50	50	13	15	17	19	21	21	24	32	12	13	14	16	17	17	19	22	10	11	12	14	15	15	16	19
	25	25	14	18	19	22	24	24	27	36	13	14	16	18	19	19	21	24	11	12	14	15	16	16	18	21
25	90	90	8	10	11	11	12	12	14	19	8	8	9	12	12	12	14	16	7	7	8	10	11	11	12	14
	75	75	10	12	13	14	15	15	17	23	9	10	11	13	14	14	16	18	8	8	9	12	12	12	14	16
	50	50	12	15	16	17	18	19	21	28	10	11	13	16	17	17	18	21	9	10	11	13	14	14	16	18
	25	25	14	17	19	20	22	22	24	33	12	13	14	18	19	19	21	24	10	11	12	15	16	16	18	21
25	90	90	16	20	21	23	25	25	28	38	13	14	16	19	21	21	23	27	11	12	14	17	18	18	20	23

Note:
 1. Width is dimension away from body in cm
 2. Distance is vertical lift in cm
 3. Percent pertains to industrial population
 4. Italicized values exceed 8 hr physiological criteria

Maximum Acceptable Weight of Lower for Females (kg)

Width	Distance	Percent	Floor level to knuckle height One lift every								Knuckle height to shoulder height One lift every								Shoulder height to arm reach One lift every							
			s				min				s				min				s				min			
			5	9	14	8	1	2	5	30	5	9	14	8	1	2	5	30	5	9	14	8	1	2	5	30
76	90	90	5	6	7	7	8	8	9	12	6	6	7	8	9	10	10	13	5	5	5	6	7	7	7	9
	75	75	6	8	8	9	10	10	11	14	7	8	8	10	11	12	12	15	5	6	6	7	8	9	9	11
	50	76	7	9	10	11	12	12	13	17	8	9	10	12	13	14	14	18	7	8	8	8	10	10	10	13
	25	76	9	11	12	12	14	14	15	20	9	11	11	13	15	17	17	21	8	9	9	10	11	12	12	15
75	90	75	10	13	13	14	15	16	17	23	11	12	13	15	17	19	19	24	9	10	10	11	12	14	14	17
	75	75	6	7	7	8	9	10	10	14	7	8	8	9	10	11	11	14	5	6	6	6	7	8	8	10
	50	75	7	8	9	10	11	12	13	17	8	9	9	11	12	13	13	17	7	7	8	8	9	10	10	12
	25	75	8	10	11	12	14	14	15	20	10	11	11	13	15	16	16	20	8	9	9	9	11	12	12	15
25	90	25	10	12	13	14	16	17	18	24	11	13	13	15	17	19	19	23	9	10	11	11	12	13	13	17
	75	25	11	13	14	16	18	19	20	27	13	15	15	17	19	21	21	26	10	12	12	12	14	15	15	19
	50	25	6	8	8	9	10	10	11	14	7	8	8	10	11	12	12	15	5	6	6	7	8	9	9	11
	10	25	8	10	10	11	12	12	13	17	8	9	9	12	13	15	15	19	7	7	8	9	10	11	11	13
49	90	25	9	11	12	13	14	15	16	21	10	11	11	14	16	18	18	22	8	9	9	10	12	13	13	16
	75	25	11	13	14	15	17	17	19	25	11	13	13	16	19	20	20	26	9	10	11	12	13	15	15	19
	50	25	12	15	16	17	19	20	21	28	13	15	15	19	21	23	23	29	10	12	12	13	15	17	17	21
	10	25	6	7	7	9	10	10	11	15	7	8	8	9	10	11	11	14	5	6	6	7	8	9	9	11
76	90	49	7	8	9	11	12	13	14	18	8	9	10	11	12	13	13	17	7	7	8	8	10	10	10	13
	75	49	8	10	11	13	15	15	16	22	10	11	11	13	15	16	16	20	8	9	9	10	11	13	13	16
	50	49	10	12	13	15	17	18	19	26	11	13	13	15	17	19	19	23	9	10	11	12	13	15	15	18
	25	49	11	13	14	17	19	20	22	29	13	15	15	17	19	21	21	26	10	12	12	13	15	16	16	21
25	90	25	6	8	8	9	10	11	12	15	7	8	8	10	11	12	12	15	5	6	6	8	9	9	9	12
	75	25	8	10	10	11	13	13	14	19	8	9	10	12	13	15	15	19	7	7	8	9	10	12	12	14
	50	25	9	11	12	14	15	16	17	23	10	11	11	14	16	18	18	22	8	9	9	11	13	14	14	17
	10	25	11	13	14	16	18	19	20	27	11	13	13	16	19	20	20	26	9	10	11	13	15	16	16	20
34	90	25	12	15	16	18	20	21	23	30	13	15	15	19	21	23	23	29	10	12	12	15	16	18	18	23
	75	25	6	8	9	9	10	11	12	15	7	8	8	9	10	11	11	14	6	6	7	8	9	9	9	12
	50	25	8	10	11	11	13	13	14	19	8	9	9	11	12	13	13	17	7	8	8	9	10	11	11	14
	10	25	10	12	13	14	15	16	17	23	10	11	11	13	15	16	16	20	8	9	10	11	13	14	14	17
25	90	25	11	14	15	16	18	19	20	27	11	13	13	15	17	19	19	23	9	11	11	13	15	16	16	20
	75	25	13	16	17	18	20	21	23	30	12	14	15	17	19	21	21	26	11	12	13	14	16	18	18	23
	50	25	7	9	9	11	12	13	14	18	8	9	9	10	11	12	12	15	7	8	8	8	10	11	11	13
	10	25	9	11	11	13	15	16	17	22	9	11	11	12	14	15	15	19	8	9	10	10	12	13	13	16
25	90	25	10	13	14	16	18	19	20	27	11	13	13	14	16	18	18	22	10	11	11	12	14	15	15	19
	75	25	12	15	16	19	21	22	24	31	13	15	15	17	19	21	21	26	11	13	13	14	16	18	18	22
	50	25	14	17	18	21	24	25	27	35	16	17	17	19	21	23	23	29	13	15	15	16	18	20	20	25
	10	25	8	10	10	11	13	13	14	19	8	9	9	11	12	13	13	17	7	8	8	9	11	12	12	15
25	90	25	10	12	13	14	15	16	17	23	9	11	11	13	15	16	16	21	8	9	10	11	13	14	14	18
	75	25	12	14	15	17	19	20	21	28	11	13	13	16	18	20	20	25	10	11	11	14	15	17	17	21
	50	25	14	17	18	20	22	23	24	33	13	15	15	18	21	23	23	29	11	13	13	16	18	19	19	24
	10	25	15	19	20	22	25	26	28	37	15	17	17	21	23	26	26	32	13	15	15	18	20	22	22	28

Note:
 1. Width is dimension away from body in cm
 2. Distance is vertical lift in cm
 3. Percent pertains to industrial population
 4. Italicized values exceed 8 hr physiological criteria

Maximum Acceptable Forces of Push for Males (kg)

Height	Percent	2.1 m push One push every								7.6 m push One push every								15.2 m push One push every								30.5 m push One push every								45.7 m push One push every								61.0 m push One push every							
		6 s	12 s	1 min	2 min	5 min	30 min	8 hr		15 s	22 s	1 min	2 min	5 min	30 min	8 hr		25 s	35 s	1 min	2 min	5 min	30 min	8 hr		1 min	2 min	5 min	30 min	8 hr		1 min	2 min	5 min	30 min	8 hr		2 min	5 min	30 min	8 hr								
Initial forces																																																	
144	90	20	22	25	25	26	26	31	14	16	21	21	22	22	26	16	18	19	19	20	21	25	15	16	19	19	24	13	14	16	16	20	12	14	14	18													
	75	26	29	32	32	34	34	41	18	20	27	27	28	28	34	21	23	25	25	26	27	32	19	21	25	25	31	16	18	21	21	26	16	18	18	23													
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	10	44	49	55	55	58	58	70	31	35	46	46	48	49	58	36	40	43	43	45	46	55	32	37	42	42	53	28	31	36	36	48	27	31	31	39													
95	90	21	24	26	26	28	28	34	16	18	23	23	25	25	30	18	21	22	22	23	24	28	17	19	22	22	27	14	16	19	19	23	14	16	16	20													
	75	28	31	34	34	36	36	44	21	23	20	20	32	32	39	24	27	28	28	30	30	36	21	24	28	28	35	18	21	24	24	30	18	21	20	26													
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	25	41	46	51	51	54	55	65	31	35	45	45	48	48	58	35	40	42	42	45	45	54	32	36	42	42	52	27	31	36	36	45	27	31	31	38													
10	47	53	59	59	62	63	75	35	40	52	52	55	56	66	40	46	49	49	52	52	62	37	41	48	48	60	32	36	41	41	52	31	35	35	44														
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	25	38	42	46	46	49	50	59	25	28	39	39	41	41	50	28	32	36	36	39	39	47	28	31	36	36	45	24	27	31	31	39	23	26	26	33													
10	43	48	53	53	57	57	68	28	32	45	45	47	48	57	32	37	42	42	44	45	54	32	36	41	41	52	27	31	36	36	44	26	30	30	38														
Sustained forces																																																	
144	90	10	13	15	16	18	18	22	8	9	13	13	15	16	18	8	9	11	12	13	14	16	8	10	12	13	16	7	8	10	11	13	7	8	9	11													
	75	13	17	21	22	24	25	30	10	13	17	18	20	21	25	11	13	15	16	18	18	22	11	13	16	18	21	10	11	13	15	18	9	11	13	15													
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	10	25	31	38	40	45	46	54	19	23	32	33	38	39	46	20	24	28	29	33	34	40	21	25	29	33	39	18	21	24	28	33	17	20	23	28													
95	90	10	13	16	17	19	19	23	8	10	13	13	15	15	18	8	10	11	12	13	13	16	8	10	12	13	16	7	8	9	11	13	7	8	9	11													
	75	14	18	22	22	25	26	31	11	13	17	18	20	21	25	11	13	15	16	18	18	21	11	13	16	18	21	9	11	13	15	18	9	11	12	15													
	50	18	23	28	29	33	34	40	14	17	22	23	26	27	32	14	17	19	20	23	23	28	15	17	20	23	27	12	14	17	19	23	12	14	16	19													
	25	22	28	34	35	40	41	49	17	21	27	29	32	33	39	18	21	24	25	28	29	34	18	21	25	28	33	15	18	21	24	28	15	17	20	23													
10	26	33	40	41	46	48	57	20	24	32	33	37	38	45	20	25	28	29	32	33	40	21	25	29	33	39	17	20	24	27	32	17	20	23	27														
64	90	10	13	16	16	18	19	23	8	10	12	13	14	15	18	8	10	11	11	12	13	15	8	9	11	13	15	7	8	9	11	13	7	8	9	10													
	75	14	18	21	22	25	26	31	11	13	17	17	19	20	24	11	13	14	15	17	17	21	11	13	15	17	20	9	11	12	14	17	9	10	12	14													
	50	18	23	28	29	32	33	39	14	17	21	22	25	26	31	14	17	19	19	22	22	27	14	16	19	22	26	12	14	16	18	22	12	14	15	18													
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10	26	32	39	41	46	48	56	20	25	30	32	36	37	44	21	25	27	28	31	32	38	20	24	28	32	37	17	20	23	26	31	16	19	22	26														

Note:
 1. Height is vertical floor to hands in cm
 2. Percent pertains to industrial population
 3. Initial force - required to start motion
 4. Sustained force - required to maintain motion
 4. Italicized values exceed 8 hr physiological criteria

Maximum Acceptable Forces of Pull for Males (kg)

Height	Percent	2.1 m pull							7.6 m pull							15.2 m pull							30.5 m pull					45.7 m pull					61.0 m pull			
		One pull every							One pull every							One pull every							One pull every					One pull every					One pull every			
		6	12	1	2	5	30	8	15	22	1	2	5	30	8	25	35	1	2	5	30	8	1	2	5	30	8	1	2	5	30	8	2	5	30	8
		s	min					hr	s	min					hr	s	min					hr	min					hr	min				hr			
		Initial forces																																		
144	90	14	16	18	18	19	19	23	11	13	16	16	17	18	21	13	15	15	15	16	17	20	12	13	15	15	19	10	11	13	13	16	10	11	11	14
	75	17	19	22	22	23	24	28	14	15	20	20	21	21	26	16	18	19	19	20	20	24	14	16	19	19	23	12	14	16	16	20	12	14	14	17
	50	20	23	26	26	28	28	33	16	18	24	24	25	26	31	19	21	22	22	24	24	29	17	19	22	22	27	15	16	19	19	24	14	16	16	20
	25	24	27	31	31	32	33	39	19	21	28	28	29	30	36	22	25	26	26	28	28	33	20	22	26	26	32	17	19	22	22	28	16	19	19	24
	10	26	30	34	34	36	37	44	21	24	31	31	33	33	40	24	28	29	29	31	31	38	22	25	29	29	37	20	22	25	25	31	18	21	21	27
95	90	19	22	25	25	27	27	32	15	18	23	23	24	29	18	20	21	21	23	23	28	16	18	21	21	26	14	16	18	18	23	13	16	16	19	
	75	23	27	31	31	32	33	39	19	21	28	28	29	30	36	22	25	26	26	28	28	33	20	22	26	26	32	17	19	22	22	28	16	19	19	24
	50	28	32	36	36	39	39	47	23	26	33	33	35	42	26	29	31	31	33	33	40	24	27	31	31	38	20	23	27	27	33	20	23	23	28	
	25	33	37	42	42	45	45	54	26	3	39	39	41	41	49	30	34	36	36	38	39	46	27	31	36	36	45	24	27	31	31	38	23	26	26	33
	10	37	42	48	48	51	51	61	30	33	43	43	46	47	56	33	38	41	41	43	44	52	31	35	40	40	50	27	30	35	35	43	26	30	30	37
64	90	22	25	28	28	30	30	36	18	20	26	26	27	28	33	20	23	24	24	26	26	31	18	21	24	24	30	16	18	21	21	26	15	18	18	22
	75	27	30	34	34	37	37	44	21	24	31	31	33	34	40	24	28	29	29	31	32	38	22	25	29	29	36	19	22	25	25	31	19	21	21	27
	50	32	36	41	41	44	44	53	25	29	37	37	40	40	48	29	33	35	35	37	38	45	27	20	35	35	43	23	26	30	30	37	22	26	26	32
	25	37	42	48	48	51	51	61	30	34	44	44	46	47	56	34	39	41	41	43	44	52	31	35	41	41	50	27	30	35	35	43	26	30	30	37
	10	42	48	54	54	57	58	69	33	38	49	49	52	53	63	38	43	46	46	49	49	59	35	39	46	46	57	30	34	39	39	49	29	34	34	42
		Sustained forces																																		
144	90	8	10	12	13	15	15	18	6	8	10	11	12	12	15	7	8	9	9	10	11	13	7	8	9	11	13	6	7	8	9	10	6	7	7	9
	75	10	13	16	17	19	20	23	8	10	13	14	16	16	19	9	10	12	12	14	14	17	9	10	12	14	16	7	9	10	11	14	7	8	10	11
	50	13	16	20	21	23	24	28	10	13	16	17	19	20	23	11	13	14	15	17	17	20	11	13	15	17	20	9	11	12	14	17	9	10	12	14
	25	15	20	24	25	28	29	34	12	15	20	20	23	24	28	13	15	17	18	20	21	24	13	15	18	20	24	11	13	15	17	20	11	12	14	17
	10	17	22	27	28	32	33	39	14	17	22	23	26	27	32	14	17	19	20	23	24	28	15	17	20	23	27	12	14	17	19	23	12	14	16	19
95	90	10	13	16	17	19	20	24	8	10	13	14	16	16	19	9	10	12	12	14	14	17	9	10	12	14	17	7	9	10	12	14	7	9	10	12
	75	13	17	21	22	25	26	30	11	13	17	18	20	21	25	11	14	15	15	18	18	22	12	13	16	18	21	10	11	13	15	18	9	11	13	15
	50	16	21	26	27	31	21	37	13	17	21	22	25	26	31	14	17	19	19	22	23	27	14	17	19	22	26	12	14	16	19	22	12	14	16	18
	25	19	26	31	33	37	38	45	16	20	26	27	30	31	37	17	20	22	23	26	27	32	17	20	23	27	32	14	17	19	22	26	14	16	19	22
	10	22	29	36	37	42	43	51	18	23	29	31	34	36	42	19	23	26	27	30	31	37	19	23	27	31	36	16	19	22	25	30	16	19	21	25
64	90	11	14	17	18	20	21	25	9	11	14	15	17	17	20	9	11	12	13	15	15	18	9	11	13	15	18	8	9	11	12	15	8	9	10	12
	75	14	19	23	23	26	27	32	11	14	19	19	22	22	26	12	14	16	17	19	19	23	12	14	17	19	23	10	12	14	16	19	10	12	13	16
	50	17	23	28	29	32	34	40	14	18	23	24	27	28	33	15	18	20	21	23	24	28	15	18	21	24	27	13	15	17	20	23	12	14	16	20
	25	20	27	33	35	39	40	48	17	21	27	28	32	33	39	18	21	24	25	28	29	34	18	21	25	28	33	15	18	21	24	28	15	17	20	25
	10	23	31	38	40	45	46	54	19	24	31	32	37	38	45	20	24	27	28	32	33	39	21	24	28	32	38	17	20	24	27	32	17	20	23	27

Note:
 1. Height is vertical floor to hands in cm
 2. Percent pertains to industrial population
 3. Initial force - required to start motion
 4. Sustained force - required to maintain motion
 4. Italicized values exceed 8 hr physiological criteria

Maximum Acceptable Forces of Pull for Females (kg)

Height	Percent	2.1 m pull One pull every								7.6 m pull One pull every								15.2 m pull One pull every								30.5 m pull One pull every								45.7 m pull One pull every								61.0 m pull One pull every							
		6 s	12 s	1 min	2 min	5 min	30 min	8 hr	15 s	22 s	1 min	2 min	5 min	30 min	8 hr	25 s	35 s	1 min	2 min	5 min	30 min	8 hr	1 min	2 min	5 min	30 min	8 hr	1 min	2 min	5 min	30 min	8 hr	2 min	5 min	30 min	8 hr													
Initial forces																																																	
144	90	13	16	17	18	20	21	22	13	14	16	16	18	19	20	10	12	13	14	15	16	17	12	13	14	15	17	12	13	14	15	17	12	13	14	15													
	75	16	19	20	21	24	25	26	16	17	19	19	21	22	24	12	14	16	16	18	19	20	14	16	17	18	20	14	16	17	18	20	14	15	16	18													
	50	19	22	24	25	28	29	31	19	20	22	23	25	26	28	14	16	19	19	21	22	24	17	18	20	21	24	17	18	20	21	24	16	18	19	21													
	25	21	25	28	29	32	33	35	21	26	25	26	29	30	32	16	19	21	22	25	26	27	19	21	23	24	27	19	21	23	24	27	19	20	22	25													
	10	24	28	31	32	36	37	39	24	26	28	29	32	34	36	18	21	24	25	27	29	30	22	24	25	27	31	22	24	25	27	31	21	23	24	27													
95	90	14	16	18	19	21	22	23	14	15	16	17	19	20	21	10	12	14	14	16	17	18	13	14	15	16	18	13	14	15	16	18	12	13	14	16													
	75	16	19	21	22	25	26	27	17	18	19	20	22	23	25	12	15	17	17	19	20	21	15	16	18	19	21	15	16	18	19	21	15	16	17	19													
	50	19	23	25	26	29	30	32	19	21	23	24	26	27	29	14	17	19	20	22	23	25	18	19	21	22	25	18	19	21	22	25	17	18	20	22													
	25	22	26	29	30	33	35	37	22	24	26	27	30	31	33	16	20	22	23	26	27	28	20	22	24	25	29	20	22	24	25	29	20	21	23	26													
	10	25	29	32	33	37	39	41	25	27	29	30	33	35	37	18	22	25	26	29	30	32	23	25	26	28	32	23	25	26	28	32	22	24	25	29													
64	90	15	17	19	20	22	23	24	15	16	17	18	20	21	22	11	13	15	15	17	18	19	13	14	15	17	19	13	14	15	17	19	13	14	15	17													
	75	17	20	22	23	26	27	28	17	19	20	21	23	24	26	13	15	17	18	20	21	22	16	17	18	20	22	16	17	18	20	22	15	16	18	20													
	50	20	24	26	27	30	32	33	20	22	24	25	28	29	30	15	18	20	21	23	24	26	18	20	22	23	26	18	20	22	23	26	18	19	21	23													
	25	23	27	30	31	35	36	38	23	25	27	29	32	33	35	17	21	23	24	27	28	30	21	23	25	27	30	21	23	25	27	30	21	22	24	27													
	10	26	31	34	35	39	40	43	29	28	31	32	35	37	39	19	23	26	27	30	31	33	24	26	28	30	34	24	26	28	30	34	23	25	27	30													
Sustained forces																																																	
144	90	6	9	10	10	11	12	15	7	8	9	9	10	11	13	6	7	7	8	8	9	11	6	7	7	8	10	6	6	7	7	9	5	5	5	7													
	75	8	12	13	14	15	16	20	9	11	12	12	13	14	18	7	9	10	10	11	12	15	8	9	10	10	14	8	9	9	9	12	7	7	7	10													
	50	10	16	17	18	19	21	25	12	13	15	16	17	18	22	9	11	13	13	14	15	19	11	12	12	13	17	10	11	11	12	16	8	9	9	12													
	25	13	19	21	21	23	25	31	14	16	18	19	21	22	27	11	14	15	16	17	19	23	13	15	15	16	21	12	12	14	14	19	10	11	11	15													
	10	15	22	24	25	27	29	36	16	19	21	22	24	26	32	13	16	18	18	20	22	27	15	17	17	18	25	14	15	16	17	23	12	12	13	17													
95	90	6	9	10	10	11	12	14	7	8	9	9	10	10	13	5	6	7	7	8	9	11	6	7	7	7	10	5	6	6	7	9	5	5	5	7													
	75	8	12	13	13	15	16	19	9	10	11	12	13	14	17	7	8	10	10	11	12	14	8	9	9	10	13	7	8	9	9	12	6	7	7	9													
	50	10	15	16	17	19	20	25	11	13	15	15	16	18	22	9	11	12	13	14	15	18	10	12	12	13	17	9	11	11	12	15	8	8	9	12													
	25	12	18	20	21	23	24	30	14	16	18	18	20	22	27	11	13	15	15	17	18	22	12	14	15	15	21	11	13	13	14	19	10	10	11	15													
	10	14	21	23	24	26	28	35	16	18	21	21	23	25	31	13	15	17	18	20	21	26	15	16	17	18	24	13	15	16	16	22	12	12	13	17													
64	90	5	8	9	9	10	11	13	6	7	8	8	9	10	12	5	6	7	7	7	8	10	6	6	6	7	9	5	6	6	6	8	4	5	5	6													
	75	7	11	12	12	13	14	18	8	9	11	11	12	13	16	7	8	9	9	10	11	13	7	8	9	9	12	7	8	8	8	11	6	6	6	9													
	50	9	14	15	16	17	18	23	10	12	13	14	15	16	20	8	10	11	12	13	14	17	9	11	11	12	16	9	10	10	11	14	8	8	8	11													
	25	11	17	18	19	21	22	27	13	15	16	17	19	20	24	10	12	14	14	16	17	21	11	13	13	14	19	11	12	12	13	17	9	10	10	13													
	10	13	20	21	22	24	26	32	15	17	19	20	22	23	28	12	14	16	16	18	19	24	13	15	16	16	22	12	14	14	15	20	11	11	12	16													

Note:
 1. Height is vertical floor to hands in cm
 2. Percent pertains to industrial population
 3. Initial force - required to start motion
 4. Sustained force - required to maintain motion
 4. Italicized values exceed 8 hr physiological criteria

Maximum Acceptable Weight of Carry (kg)

Height	Percent	2.1 m carry							4.3 m carry							8.5 m carry						
		One carry every							One carry every							One carry every						
		6 s	12 s	1 min	2 min	5 min	30 min	8 hr	6 s	12 s	1 min	2 min	5 min	30 min	8 hr	6 s	12 s	1 min	2 min	5 min	30 min	8 hr
Males																						
111	90	10	14	17	17	19	21	25	9	11	15	15	17	19	22	10	11	13	13	15	17	20
	75	14	19	23	23	26	29	34	13	16	21	21	23	26	30	13	15	18	18	20	23	27
	50	19	25	30	30	33	38	44	17	20	27	27	30	34	39	17	19	23	24	26	29	35
	25	23	30	37	37	41	46	54	20	25	33	33	37	41	48	21	24	29	29	32	36	43
	10	27	35	43	43	48	54	63	24	29	38	39	43	48	57	24	28	34	34	38	42	50
79	90	13	17	21	21	23	26	31	11	14	18	19	21	23	27	13	15	17	18	20	22	26
	75	18	23	28	29	32	36	42	16	19	25	25	28	32	37	17	20	24	24	27	30	35
	50	23	30	37	37	41	46	54	20	25	32	33	36	41	48	22	26	31	31	35	39	46
	25	28	37	45	46	51	57	67	25	30	40	40	45	50	59	27	32	38	38	42	48	56
	10	33	43	53	53	59	66	78	29	35	47	47	52	59	69	32	38	44	45	50	56	65
Females																						
105	90	11	12	13	13	13	13	18	9	10	13	13	13	13	18	10	11	12	12	12	12	16
	75	13	14	15	15	16	16	21	11	12	15	15	16	16	21	12	13	14	14	14	14	19
	50	15	16	18	18	18	18	25	12	13	18	18	18	18	24	14	15	16	16	16	16	22
	25	17	18	20	20	21	21	28	14	15	20	20	21	21	28	15	17	18	18	19	19	25
	10	19	20	22	22	23	23	31	16	17	22	22	23	23	31	17	19	20	20	21	21	28
72	90	13	14	16	16	16	16	22	10	11	14	14	14	14	20	12	12	14	14	14	14	19
	75	15	17	18	18	19	19	25	11	13	16	16	17	17	23	14	15	16	16	17	17	23
	50	17	19	21	21	22	22	29	13	15	19	19	20	20	26	16	17	19	19	20	20	26
	25	20	22	24	24	25	25	33	15	17	22	22	22	22	30	18	19	21	22	22	22	30
	10	22	24	27	27	28	28	37	17	19	24	24	25	25	33	20	21	24	24	25	25	33

- Notes:
1. Height is vertical distance floor to hands
 2. Percent pertains to industrial population
 3. Italicized values exceed 8 hr physiological criteria