

# Liberty Mutual Tables for Lifting, Carrying, Pushing and Pulling

Also known as the Snook Tables

## Design Goals -- MKS Units -- centimeters, meters and kilograms

From

S. H. Snook and V. M. Ciriello

The design of manual handling tasks: revised tables of maximum acceptable weights and forces  
*Ergonomics* 34(9):1197-1213, 1991

Notes on reported values:

For design goals, 75% acceptable for women was selected as the appropriate target.

In some cases, multipliers (adjustment factors) are provided to adjust to 75% acceptable for males and to an upper limit representing 25% acceptable for men.

The format and some content of the tables have been changed from the original. There was also a harmonization of frequencies in the carry, push, and pull tables that required some judgment of what the value should be.

In the carry, push and pull tables, OR (out of range) is used for some combinations of frequency and distance that were not in the reported range of results.

Acknowledgments:

This incarnation of the data set is dedicated to Vincent Ciriello, whose effort is often overlooked.

The research for these tables was funded and performed by Liberty Mutual Insurance Company. The tables have been adapted by Thomas E. Bernard with some support from the OSHA Salt Lake Technical Center.

Special thanks are offered to Jill Roberts for her help in moving the data to electronic format.

For more information:

Thomas E. Bernard  
University of South Florida  
College of Public Health  
Tampa FL 33612-3805

813-947-6629 // [tbernard@hsc.usf.edu](mailto:tbernard@hsc.usf.edu)

For updates, see Stone Wheels on [www.hsc.usf.edu/~tbernard](http://www.hsc.usf.edu/~tbernard) or, perhaps someday, the OSHA Ergonomics web site.

No warranty, explicit or implied

v2.2 10/22/02 © 2002 Thomas E. Bernard

## Liberty Mutual Design Goals for Lifting / Lowering

mks units

Loads in kilograms

### Above Shoulder

(above 138 cm)

Frequency of Lift		Horizontal Distance (Front of Body to Hands) [cm]								
		17			25			38		
		Distance of Lift [cm]			Distance of Lift [cm]			Distance of Lift [cm]		
		25	51	76	25	51	76	25	51	76
1 / 8 h	1 / 8 h	16	14	13	13	12	11	12	11	10
1 / 30 min	2 / 1 h	14	12	11	11	10	9	10	9	8
1 / 5 min	12 / 1 h	12	11	10	10	9	8	9	9	8
1 / 2 min	30 / 1 h	12	11	10	10	9	8	9	9	8
1 / 1 min	1 / 1 min	12	11	9	9	9	8	9	8	7
1 / 14 s	4.3 / 1 min	9	9	8	8	8	6	8	8	6
1 / 9 s	6.7 / 1 min	8	8	7	7	7	6	7	7	6
1 / 5 s	12 / 1 min	8	8	6	6	6	5	6	6	5

### Knuckle to Shoulder

(between 74 and 138 cm)

Frequency of Lift		Horizontal Distance (Front of Body to Hands) [cm]								
		17			25			38		
		Distance of Lift [cm]			Distance of Lift [cm]			Distance of Lift [cm]		
		25	51	76	25	51	76	25	51	76
1 / 8 h	1 / 8 h	18	17	15	17	15	14	17	15	14
1 / 30 min	2 / 1 h	16	14	13	14	13	12	14	13	12
1 / 5 min	12 / 1 h	14	13	12	13	12	11	13	12	11
1 / 2 min	30 / 1 h	14	13	12	13	12	11	13	12	11
1 / 1 min	1 / 1 min	13	12	11	12	11	10	12	11	10
1 / 14 s	4.3 / 1 min	11	11	9	9	9	8	9	9	8
1 / 9 s	6.7 / 1 min	10	10	8	8	8	7	8	8	7
1 / 5 s	12 / 1 min	9	9	7	7	7	6	7	7	6

### Floor to Knuckle

(below 74 cm)

Frequency of Lift		Horizontal Distance (Front of Body to Hands) [cm]								
		17			25			38		
		Distance of Lift [cm]			Distance of Lift [cm]			Distance of Lift [cm]		
		25	51	76	25	51	76	25	51	76
1 / 8 h	1 / 8 h	23	22	19	19	18	16	18	17	14
1 / 30 min	2 / 1 h	17	16	14	14	14	12	13	13	11
1 / 5 min	12 / 1 h	15	15	13	13	12	10	12	11	10
1 / 2 min	30 / 1 h	15	15	13	12	12	10	12	11	10
1 / 1 min	1 / 1 min	14	14	12	12	11	10	11	10	9
1 / 14 s	4.3 / 1 min	13	12	11	11	9	9	11	9	9
1 / 9 s	6.7 / 1 min	12	11	10	10	9	8	10	9	8
1 / 5 s	12 / 1 min	10	9	8	8	7	7	8	7	7

Adaptation of the Tables published by Snook and Ciriello in 1991.

The Design Goal is 75% Acceptable for Women.

### Adjustment Factors

The Design Goal for Men only may be 2 times higher than the table values.

The Design Goal for Lowering is approximately the same as Lifting.

The Upper Design Limit for Lifting (equivalent to 25% Acceptable for Men) is about 2.7 times the table value.

The Upper Design Limit for Lowering (equivalent to 25% Acceptable for Men) is about 3 times the table value.

## Liberty Mutual Design Goals for Carrying

mks units

Loads in kilograms (OR = Out of Range of Tables)

Carrying at about waist height

(elbows bent)

Frequency		Distance of Carry [m]		
		2.1	4.3	8.5
1 / 8 h	1 / 8 h	21	21	19
1 / 30 min	2 / 1 h	16	16	14
1 / 5 min	12 / 1 h	16	16	14
1 / 2 min	30 / 1 h	15	15	14
1 / 1 min	1 / 1 min	15	15	14
1 / 20 s	3 / 1 min	14	12	12
1 / 10 s	6 / 1 min	13	11	OR

Carrying with arms extended below waist

(elbows straight)

Frequency		Distance of Carry [m]		
		2.1	4.3	8.5
1 / 8 h	1 / 8 h	25	23	23
1 / 30 min	2 / 1 h	19	17	17
1 / 5 min	12 / 1 h	19	17	17
1 / 2 min	30 / 1 h	18	16	16
1 / 1 min	1 / 1 min	18	16	16
1 / 20 s	3 / 1 min	17	13	14
1 / 10 s	6 / 1 min	16	11	OR

Adaptation of the Tables published by Snook and Ciriello in 1991.

The Design Goal is 75% Acceptable for Women.

Adjustment Factors

The Design Goal for Men varies from about 1 to 2.4 times higher than the table values, which makes using a single number difficult.

The Upper Design Limit for Carrying (equivalent to 25% Acceptable for Men)

is 1.8 to 2.6 times the table value, where 2 is a reasonable factor.

**Liberty Mutual Design Goals for Pushing**  
mks units  
Forces in kilograms (OR = Out of Range of Tables)

**High Push Point**  
(hands about 140 cm)

Frequency	Push Distance [m]											
	2.1		7.6		15.2		30.5		45.7		61.0	
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained
1 / 8 h	27	21	24	16	21	13	21	12	21	11	19	9
1 / 30 min	25	17	23	13	20	11	19	9	19	8	17	6
1 / 5 min	24	16	22	12	19	10	17	9	17	8	15	6
1 / 2 min	22	14	20	11	17	9	16	8	16	8	14	6
1 / 1 min	21	14	20	11	17	9	15	7	15	7	OR	OR
1 / 30 s	20	14	19	10	17	8	OR	OR	OR	OR	OR	OR
1 / 15 s	19	12	17	9	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	18	12	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	17	9	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

**Middle Push Point**  
(hands about 92 cm)

Frequency	Push Distance [m]											
	2.1		7.6		15.2		30.5		45.7		61.0	
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained
1 / 8 h	27	19	25	17	21	14	21	13	21	12	19	9
1 / 30 min	25	16	23	13	20	11	19	10	19	9	17	7
1 / 5 min	24	15	22	13	19	11	18	9	18	8	16	6
1 / 2 min	22	13	20	11	17	10	16	9	16	8	15	6
1 / 1 min	21	13	20	11	17	9	15	8	15	7	OR	OR
1 / 30 s	20	13	19	10	16	8	OR	OR	OR	OR	OR	OR
1 / 15 s	19	12	17	9	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	18	11	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	17	8	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

**Low Push Point**  
(hands about 60 cm)

Frequency	Push Distance [m]											
	2.1		7.6		15.2		30.5		45.7		61.0	
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained
1 / 8 h	21	17	21	15	18	13	18	12	18	11	16	8
1 / 30 min	20	14	20	12	17	10	16	9	16	8	14	6
1 / 5 min	19	13	19	12	16	10	15	8	15	8	13	6
1 / 2 min	17	12	17	11	15	9	14	8	14	7	12	6
1 / 1 min	17	11	17	10	14	9	13	7	13	7	OR	OR
1 / 30 s	16	11	16	10	13	8	OR	OR	OR	OR	OR	OR
1 / 15 s	15	10	14	8	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	15	9	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	14	7	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

Adaptation of the Tables published by Snook and Ciriello in 1991.  
The Design Goal is 75% Acceptable for Women.

Adjustment Factors

The Design Goal for Men only may be 1.5 times higher than the table values, with variation from 1 to 2.

The Upper Design Limit for Lifting (equivalent to 25% Acceptable for Men) is about 1.5 times the table value, with variations of 1 to 3.

### Liberty Mutual Design Goals for Pulling

mks units

Forces in kilograms (OR = Out of Range of Tables)

#### High Pull Point

(hands about 140 cm)

Frequency	Pull Distance [m]											
	2.1		7.6		15.2		30.5		45.7		61.0	
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained
1 / 8 h	26	20	24	18	20	15	20	14	20	12	18	10
1 / 30 min	25	16	22	14	19	12	18	10	18	9	16	7
1 / 5 min	24	15	21	13	18	11	17	10	17	9	15	7
1 / 2 min	21	14	19	12	16	10	16	9	16	9	14	7
1 / 1 min	20	13	19	12	16	10	14	8	14	8	OR	OR
1 / 30 s	20	13	18	11	14	9	OR	OR	OR	OR	OR	OR
1 / 15 s	19	12	16	9	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	19	12	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	16	8	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

#### Middle Pull Point

(hands about 92 cm)

Frequency	Pull Distance [m]											
	2.1		7.6		15.2		30.5		45.7		61.0	
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained
1 / 8 h	27	19	25	17	21	14	21	13	21	12	19	9
1 / 30 min	26	16	23	14	20	12	19	10	19	9	17	7
1 / 5 min	25	15	22	13	19	11	18	9	18	9	16	7
1 / 2 min	22	13	20	12	17	10	16	9	16	8	15	6
1 / 1 min	21	13	19	11	17	10	15	8	15	7	OR	OR
1 / 30 s	21	13	18	11	14	8	OR	OR	OR	OR	OR	OR
1 / 15 s	20	12	17	9	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	19	12	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	16	8	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

#### Low Pull Point

(hands about 60 cm)

Frequency	Pull Distance [m]											
	2.1		7.6		15.2		30.5		45.7		61.0	
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained
1 / 8 h	28	18	26	16	22	13	22	12	22	11	20	9
1 / 30 min	27	14	24	13	21	11	20	9	20	8	18	6
1 / 5 min	26	13	23	12	20	10	18	9	18	8	16	6
1 / 2 min	23	12	21	11	18	9	17	8	17	8	15	6
1 / 1 min	22	12	20	11	17	9	16	7	16	7	OR	OR
1 / 30 s	22	12	19	10	15	8	OR	OR	OR	OR	OR	OR
1 / 15 s	21	11	17	8	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	20	11	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	17	7	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

Adaptation of the Tables published by Snook and Ciriello in 1991.

The Design Goal is 75% Acceptable for Women.

Adjustment Factors

The Design Goal for Men only may be 1.5 times higher than the table values, with variation from 1 to 2.

The Upper Design Limit for Lifting (equivalent to 25% Acceptable for Men) is about 1.5 times the table value, with variations of 1 to 3.