

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

Also known as the Snook Tables

## Design Goals -- US Traditional Units -- inches, feet and pounds

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.

The data were converted from the original tables which reported the data in mks units.

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.

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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.

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## Liberty Mutual Design Goals for Lifting / Lowering

US Traditional units

Loads in pounds

Above Shoulder

(above 54 in)

Frequency		Horizontal Distance (Front of Body to Hands) [in]								
		7			10			15		
		Distance of Lift [in]			Distance of Lift [in]			Distance of Lift [in]		
		10	20	30	10	20	30	10	20	30
1 / 8 h	1 / 8 h	35	31	29	29	26	24	26	24	22
1 / 30 min	2 / 1 h	31	26	24	24	22	20	22	20	18
1 / 5 min	12 / 1 h	26	24	22	22	20	18	20	20	18
1 / 2 min	30 / 1 h	26	24	22	22	20	18	20	20	18
1 / 1 min	1 / 1 min	26	24	20	20	20	18	20	18	15
1 / 14 s	4.3 / 1 min	20	20	18	18	18	13	18	18	13
1 / 9 s	6.7 / 1 min	18	18	15	15	15	13	15	15	13
1 / 5 s	12 / 1 min	18	18	13	13	13	11	13	13	11

Knuckle to Shoulder

(between 29 and 54 in)

Frequency		Horizontal Distance (Front of Body to Hands) [in]								
		7			10			15		
		Distance of Lift [in]			Distance of Lift [in]			Distance of Lift [in]		
		10	20	30	10	20	30	10	20	30
1 / 8 h	1 / 8 h	40	37	33	37	33	31	37	33	31
1 / 30 min	2 / 1 h	35	31	29	31	29	26	31	29	26
1 / 5 min	12 / 1 h	31	29	26	29	26	24	29	26	24
1 / 2 min	30 / 1 h	31	29	26	29	26	24	29	26	24
1 / 1 min	1 / 1 min	29	26	24	26	24	22	26	24	22
1 / 14 s	4.3 / 1 min	24	24	20	20	20	18	20	20	18
1 / 9 s	6.7 / 1 min	22	22	18	18	18	15	18	18	15
1 / 5 s	12 / 1 min	20	20	15	15	15	13	15	15	13

Floor to Knuckle

(below 29 in)

Frequency		Horizontal Distance (Front of Body to Hands) [in]								
		7			10			15		
		Distance of Lift [in]			Distance of Lift [in]			Distance of Lift [in]		
		10	20	30	10	20	30	10	20	30
1 / 8 h	1 / 8 h	51	48	42	42	40	35	40	37	31
1 / 30 min	2 / 1 h	37	35	31	31	31	26	29	29	24
1 / 5 min	12 / 1 h	33	33	29	29	26	22	26	24	22
1 / 2 min	30 / 1 h	33	33	29	26	26	22	26	24	22
1 / 1 min	1 / 1 min	31	31	26	26	24	22	24	22	20
1 / 14 s	4.3 / 1 min	29	26	24	24	20	20	24	20	20
1 / 9 s	6.7 / 1 min	26	24	22	22	20	18	22	20	18
1 / 5 s	12 / 1 min	22	20	18	18	15	15	18	15	15

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

### US Traditional Units

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

#### Carrying at about waist height

(elbows bent)

Frequency		Distance of Carry [ft]		
		7	14	27
1 / 8 h	1 / 8 h	46	46	42
1 / 30 min	2 / 1 h	35	35	31
1 / 5 min	12 / 1 h	35	35	31
1 / 2 min	30 / 1 h	33	33	31
1 / 1 min	1 / 1 min	33	33	31
1 / 20 s	3 / 1 min	31	26	26
1 / 10 s	6 / 1 min	29	24	OR

#### Carrying with arms extended below waist

(elbows straight)

Frequency		Distance of Carry [ft]		
		7	14	27
1 / 8 h	1 / 8 h	55	51	51
1 / 30 min	2 / 1 h	42	37	37
1 / 5 min	12 / 1 h	42	37	37
1 / 2 min	30 / 1 h	40	35	35
1 / 1 min	1 / 1 min	40	35	35
1 / 20 s	3 / 1 min	37	29	31
1 / 10 s	6 / 1 min	35	24	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**  
**US Traditional units**  
**Forces in pounds (OR = Out of Range of Tables)**

**High Push Point**  
(hand about 55 in)

Frequency	Push Distance [ft]												
	7		24		48		97		145		194		
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	
1 / 8 h	59	46	53	35	46	29	26	46	26	46	24	42	20
1 / 30 min	55	37	51	29	44	24	20	42	20	42	18	37	13
1 / 5 min	53	35	48	26	42	22	20	37	20	37	18	33	13
1 / 2 min	48	31	44	24	37	20	18	35	18	35	18	31	13
1 / 1 min	46	31	44	24	37	20	15	33	15	33	15	OR	OR
1 / 30 s	44	31	42	22	37	18	OR	OR	OR	OR	OR	OR	OR
1 / 15 s	42	26	37	20	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	40	26	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	37	20	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

**Middle Push Point**  
(hand about 36 in)

Frequency	Push Distance [ft]												
	7		24		48		97		145		194		
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	
1 / 8 h	59	42	55	37	46	31	29	46	29	46	26	42	20
1 / 30 min	55	35	51	29	44	24	22	42	22	42	20	37	15
1 / 5 min	53	33	48	29	42	24	20	40	20	40	18	35	13
1 / 2 min	48	29	44	24	37	22	20	35	20	35	18	33	13
1 / 1 min	46	29	44	24	37	20	18	33	18	33	15	OR	OR
1 / 30 s	44	29	42	22	35	18	OR	OR	OR	OR	OR	OR	OR
1 / 15 s	42	26	37	20	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	40	24	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	37	18	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

**Low Push Point**  
(hand about 24 in)

Frequency	Push Distance [ft]												
	7		24		48		97		145		194		
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	
1 / 8 h	46	37	46	33	40	29	26	40	26	40	24	35	18
1 / 30 min	44	31	44	26	37	22	35	35	20	35	18	31	13
1 / 5 min	42	29	42	26	35	22	33	33	18	33	18	29	13
1 / 2 min	37	26	37	24	33	20	31	31	18	31	15	26	13
1 / 1 min	37	24	37	22	31	20	29	29	15	29	15	OR	OR
1 / 30 s	35	24	35	22	29	18	OR	OR	OR	OR	OR	OR	OR
1 / 15 s	33	22	31	18	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	33	20	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	31	15	OR	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**  
**US Traditional units**  
**Forces in pounds (OR = Out of Range of Tables)**

**High Pull Point**  
(hand about 55 in)

Frequency	Pull Distance [ft]											
	7		24		48		97		145		194	
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained
1 / 8 h	57	44	53	40	44	33	44	31	44	26	40	22
1 / 30 min	55	35	48	31	42	26	40	22	40	20	35	15
1 / 5 min	53	33	46	29	40	24	37	22	37	20	33	15
1 / 2 min	46	31	42	26	35	22	35	20	35	20	31	15
1 / 1 min	44	29	42	26	35	22	31	18	31	18	OR	OR
1 / 30 s	44	29	40	24	31	20	OR	OR	OR	OR	OR	OR
1 / 15 s	42	26	35	20	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	42	26	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	35	18	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

**Middle Pull Point**  
(hand about 36 in)

Frequency	Pull Distance [ft]											
	7		24		48		97		145		194	
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained
1 / 8 h	59	42	55	37	46	31	46	29	46	26	42	20
1 / 30 min	57	35	51	31	44	26	42	22	42	20	37	15
1 / 5 min	55	33	48	29	42	24	40	20	40	20	35	15
1 / 2 min	48	29	44	26	37	22	35	20	35	18	33	13
1 / 1 min	46	29	42	24	37	22	33	18	33	15	OR	OR
1 / 30 s	46	29	40	24	31	18	OR	OR	OR	OR	OR	OR
1 / 15 s	44	26	37	20	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	42	26	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	35	18	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

**Low Pull Point**  
(hand about 24 in)

Frequency	Pull Distance [ft]											
	7		24		48		97		145		194	
	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained	Initial	Sustained
1 / 8 h	62	40	57	35	48	29	48	26	48	24	44	20
1 / 30 min	59	31	53	29	46	24	44	20	44	18	40	13
1 / 5 min	57	29	51	26	44	22	40	20	40	18	35	13
1 / 2 min	51	26	46	24	40	20	37	18	37	18	33	13
1 / 1 min	48	26	44	24	37	20	35	15	35	15	OR	OR
1 / 30 s	48	26	42	22	33	18	OR	OR	OR	OR	OR	OR
1 / 15 s	46	24	37	18	OR	OR	OR	OR	OR	OR	OR	OR
1 / 12 s	44	24	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR
1 / 6 s	37	15	OR	OR	OR	OR	OR	OR	OR	OR	OR	OR

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