

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 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
 (hands 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
 (hands 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
 (hands 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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