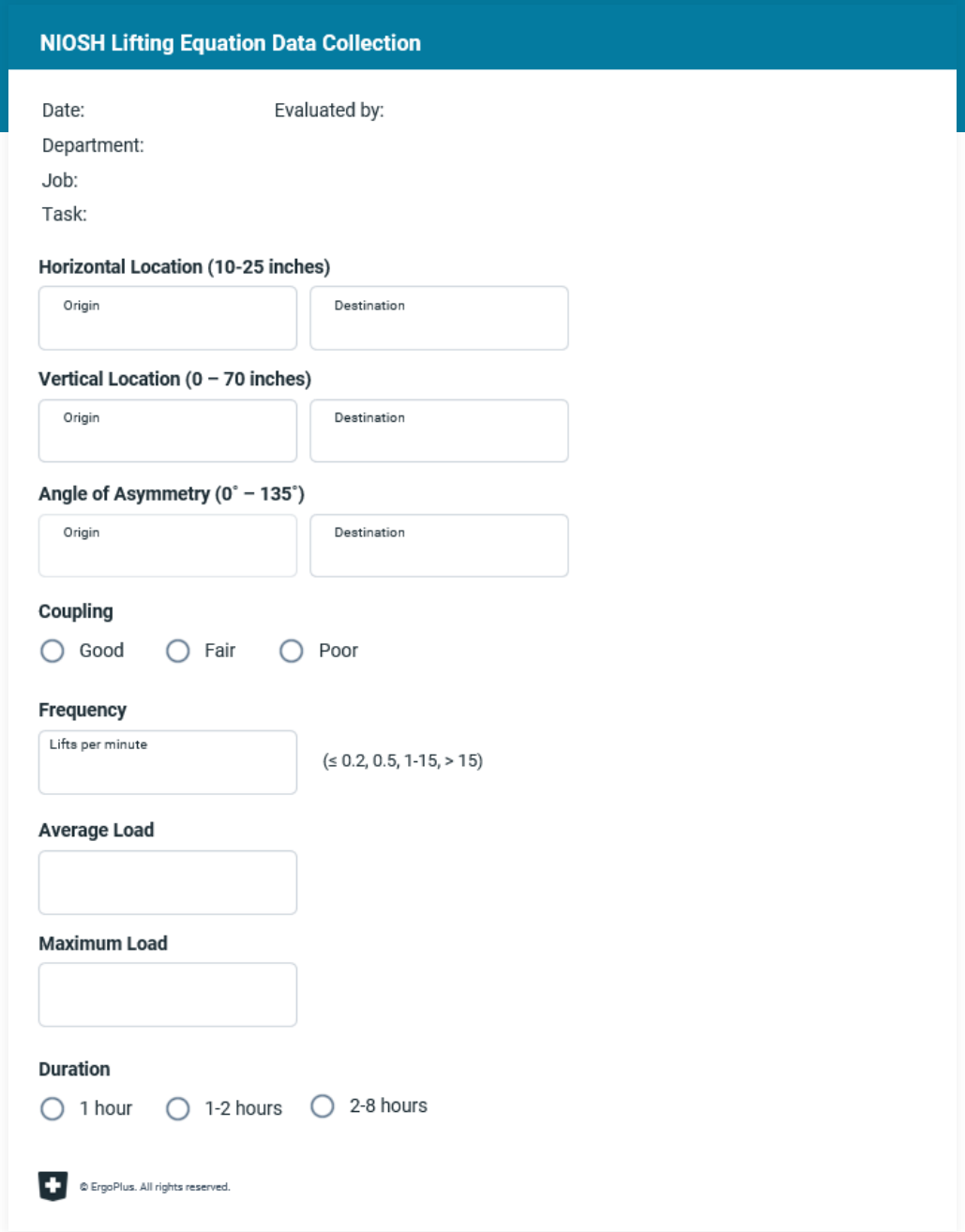
NIOSH Lifting Equation

ErgoPlus

When To Use It

- When a task has been flagged by the Job Screen
- Lifting/lowering tasks

RWL = LC (51) x HM x VM x DM x AM x FM x CM



NIOSH Lifting Equation Data Collection

Date: Evaluated by:

Department:

Job:

Task:

Horizontal Location (10-25 inches)

Origin | Destination

Vertical Location (0 – 70 inches)

Origin | Destination

Angle of Asymmetry (0° – 135°)

Origin | Destination

Coupling

Good Fair Poor

Frequency

Lifts per minute (≤ 0.2, 0.5, 1-15, > 15)

Average Load

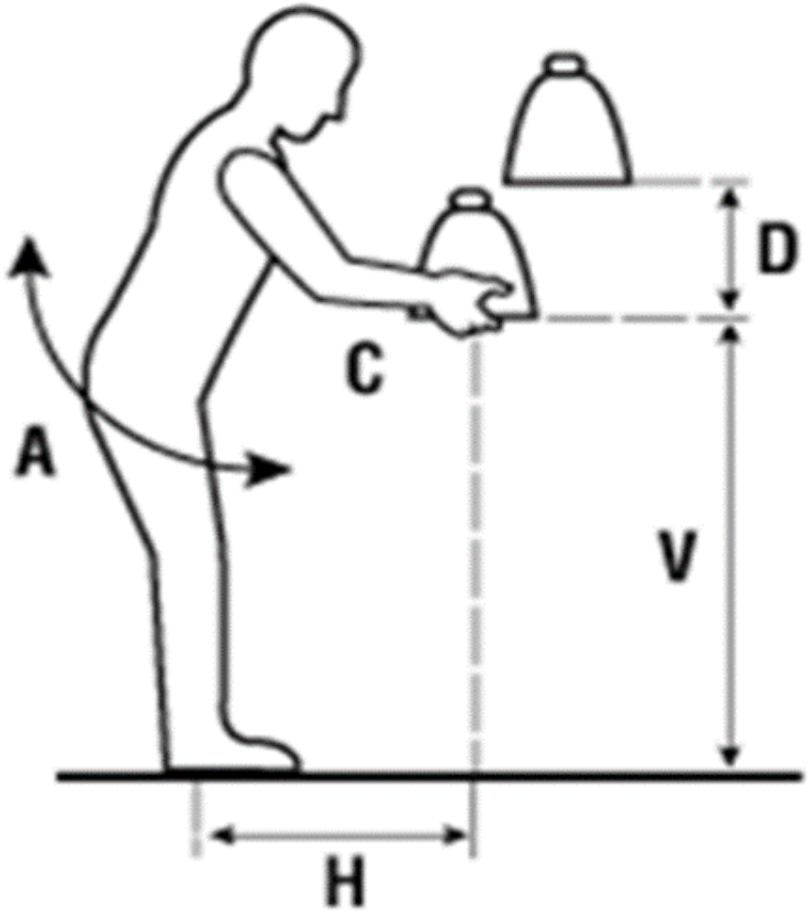
Maximum Load

Duration

1 hour 1-2 hours 2-8 hours

Inputs

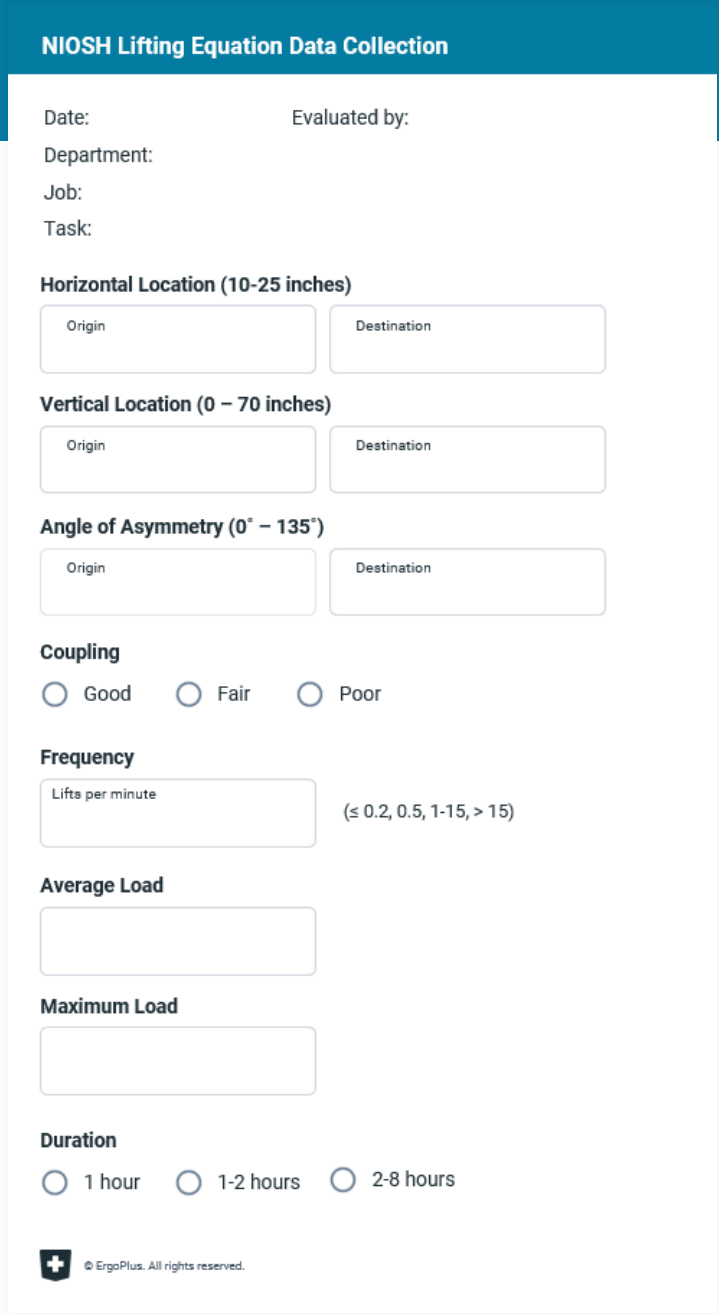
- Significant control
- Horizontal Location (origin and destination)
- Vertical Location (origin and destination)
- Angle of Asymmetry (origin and destination)
- Coupling
- Frequency
- Average Load
- Maximum Load
- Duration



Origin, Destination, and Significant Control

- **Origin**: Starting position of lift/lower
- **Destination**: Ending position of lift/lower

- **Significant control** is required at the destination of the lift when:
  - Object requires precise placement
  - Worker needs to change grip, hold, or guide the object at the destination



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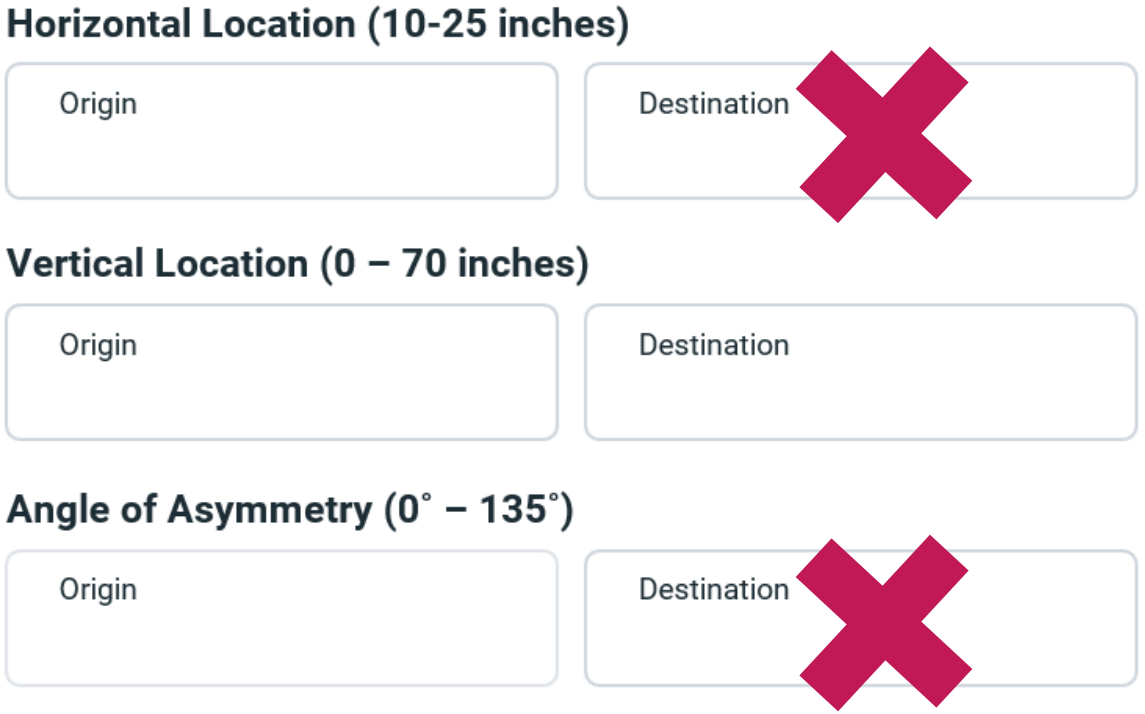
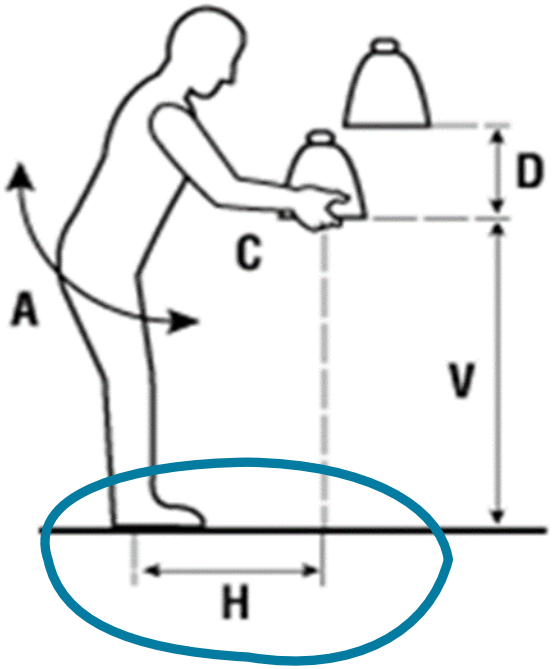
Origin, Destination, and Significant Control

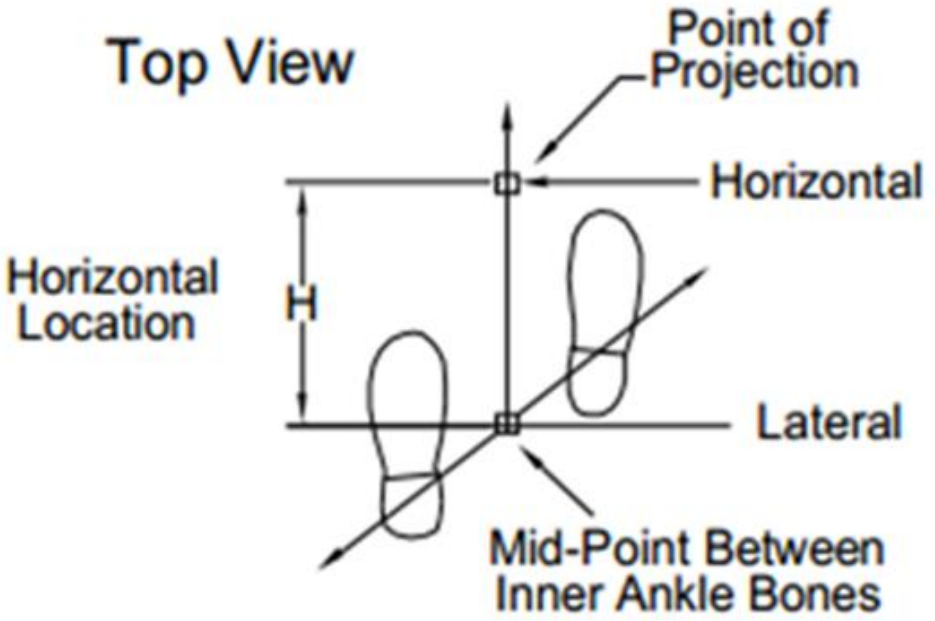
- If significant control is not required at the destination of the lift, you do not need to record the Destination variable for Horizontal Location or Angle of Asymmetry



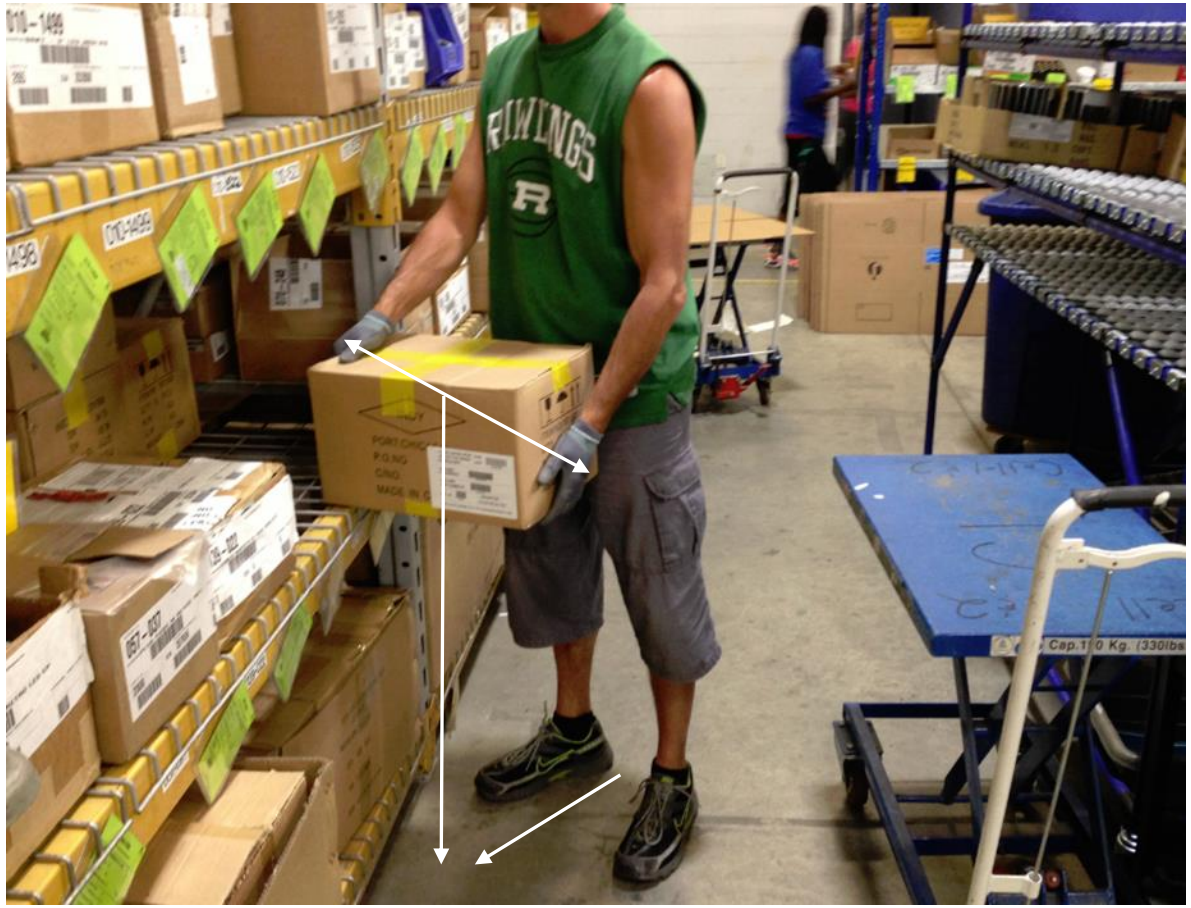
Horizontal Location

Horizontal Location of the Object (H) – Measure and record the horizontal location of the hands at the start (origin) of the lifting or lowering task. Measure and record the horizontal location of the hands at the end (destination) of the lifting task only if significant control is required.





Horizontal Location



Horizontal Location (H)

- Minimum of 10” (or 25 cm)
- Maximum of 25” (or 63 cm)

Horizontal Location

Step 1 - Determine true location of the hands at the Origin or start of the lift.

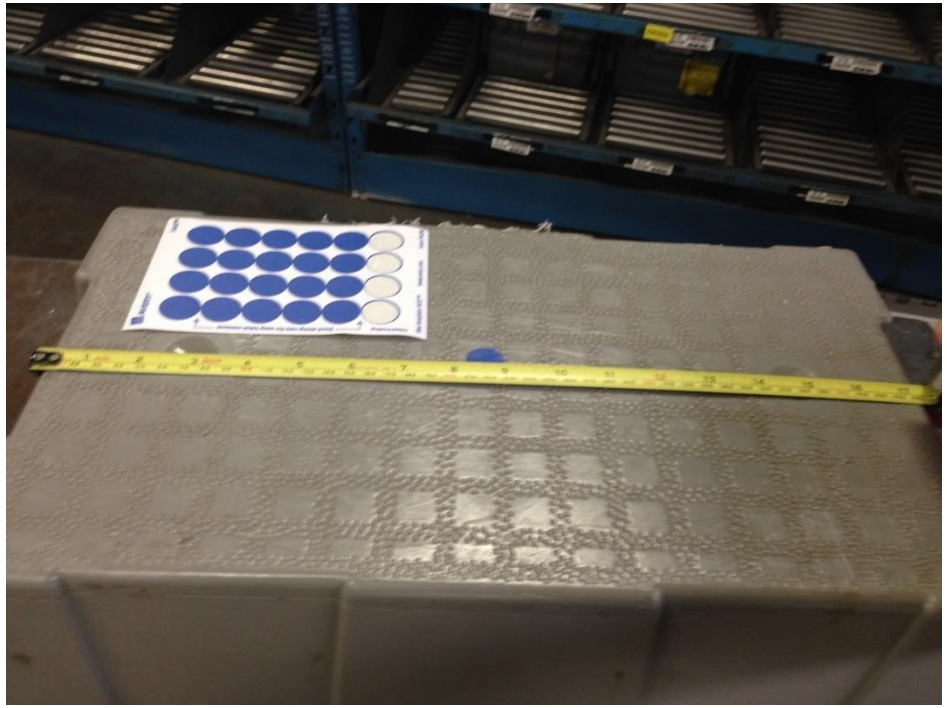
Step 2 - Determine if significant control is required at destination.

Horizontal Location

Step 3 – Determine the location of the point projected on the floor directly below the mid-point of the hands grasping the object:

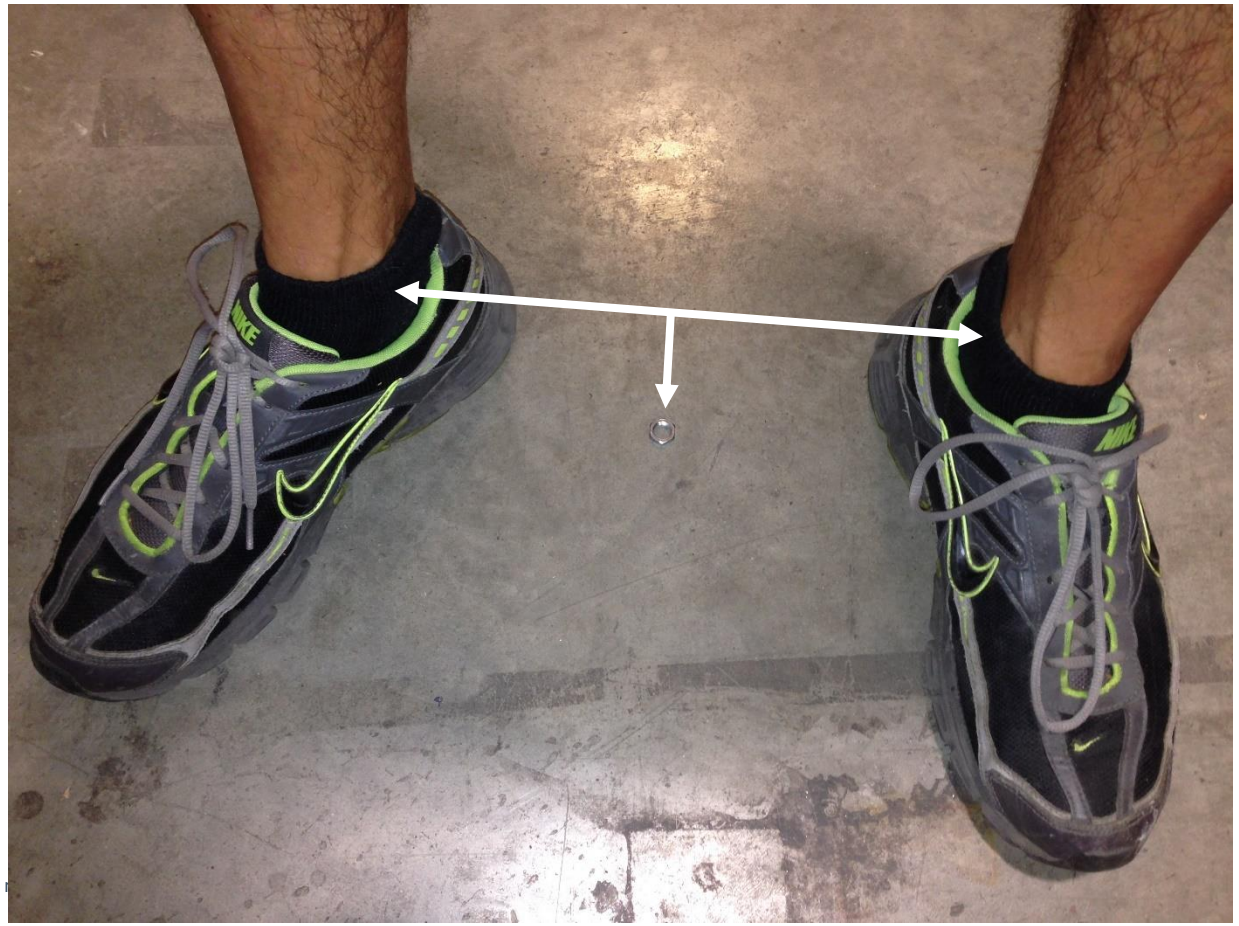
Horizontal Location

Mid-point of hands grasping the object (load center):



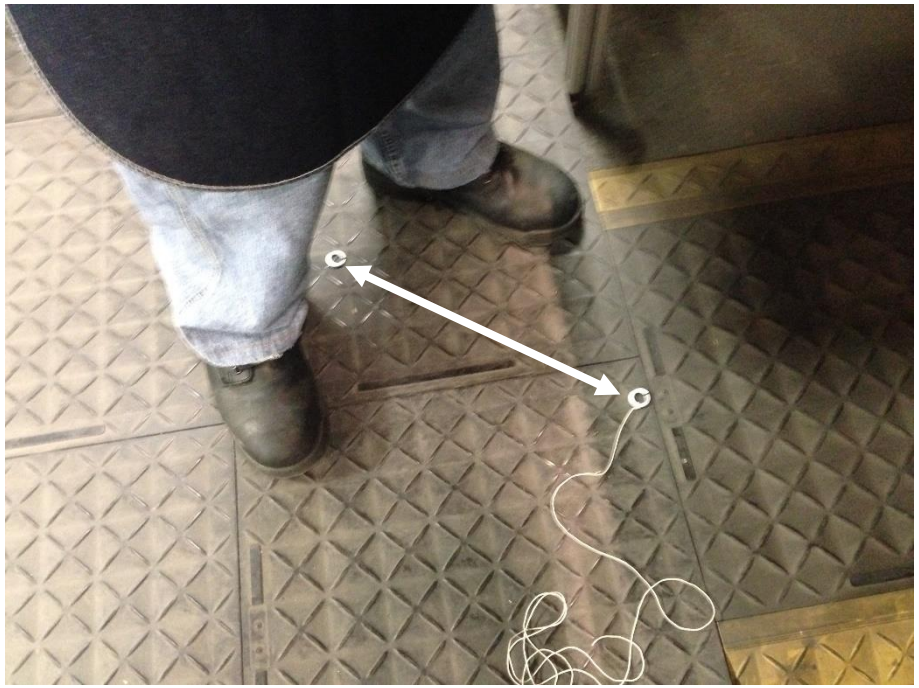
Horizontal Location

Step 4 – Determine the mid-point of a line between the inside ankle bones using tape measure, and mark that spot by placing a small washer on the floor if possible.



Horizontal Location

Step 5 – Determine the H location by measuring the distance between the two washers, and enter this number on your data collection worksheet under H at the origin of the lift.

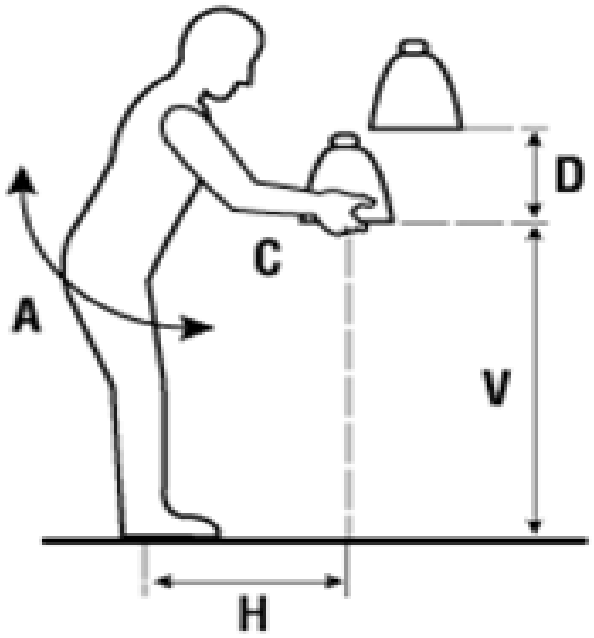


Horizontal Location

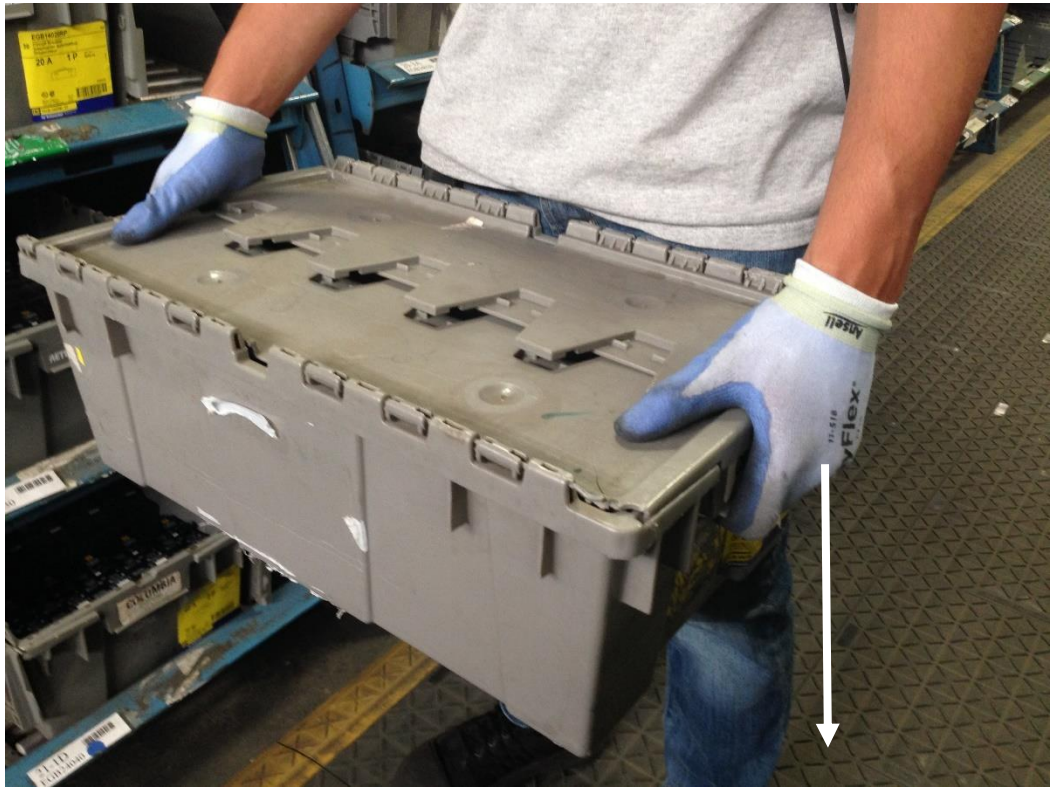
Horizontal Location

Vertical Location

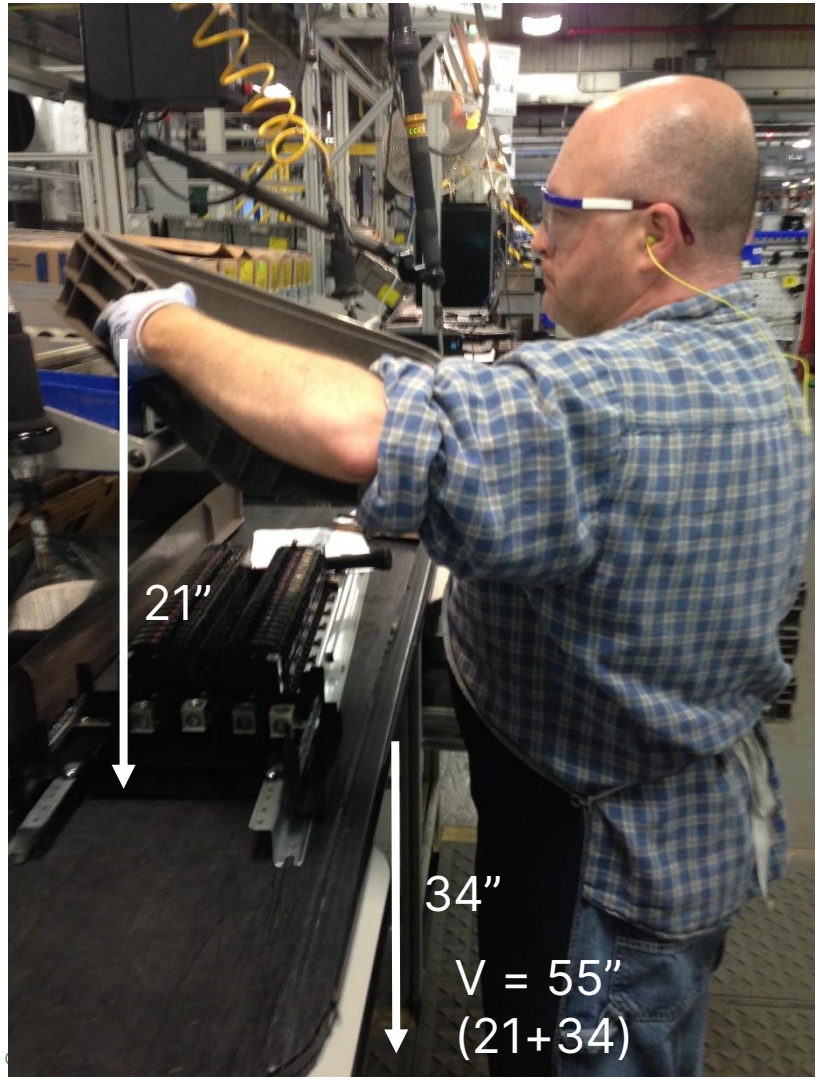
Vertical Location of the Object (V) – Measure and record the vertical location of the hands above the floor at the start (origin) and end (destination) of the lifting task. The vertical location is measured from the floor to the vertical mid-point between the two hands. The middle knuckle can be used to define the mid-point.

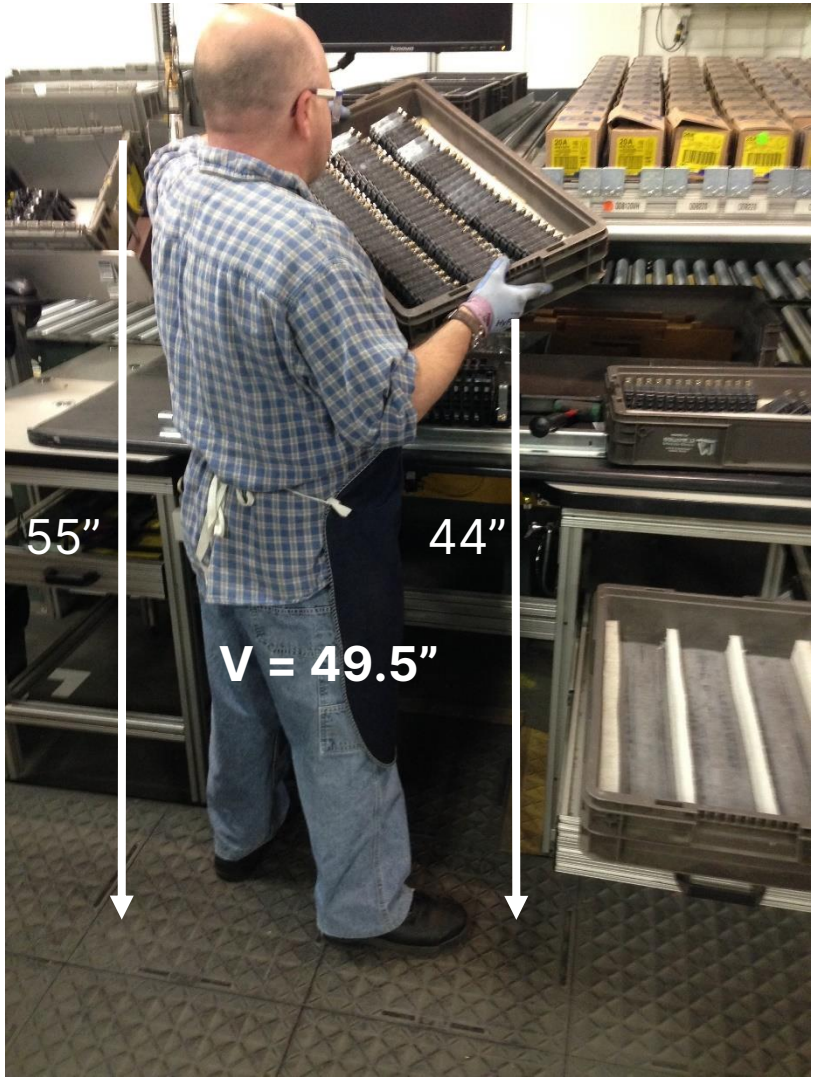


Vertical Location



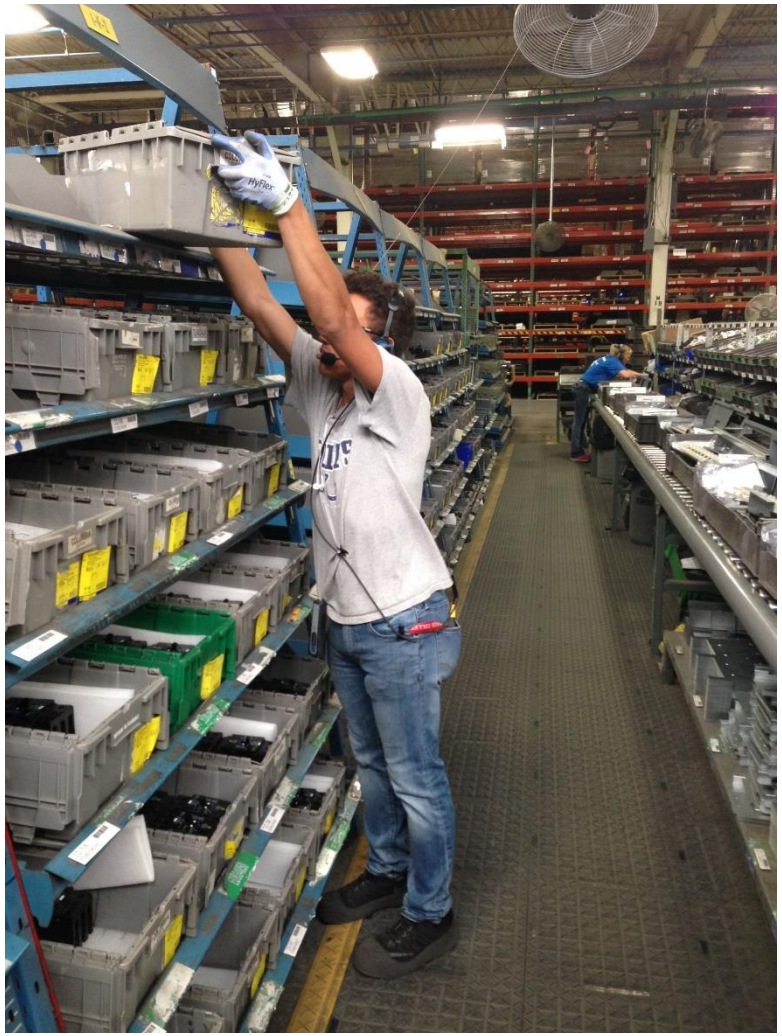
Vertical Location





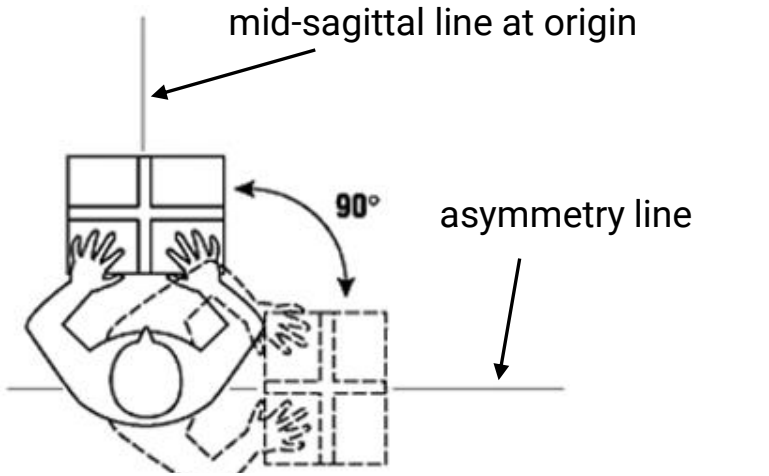
Vertical Location

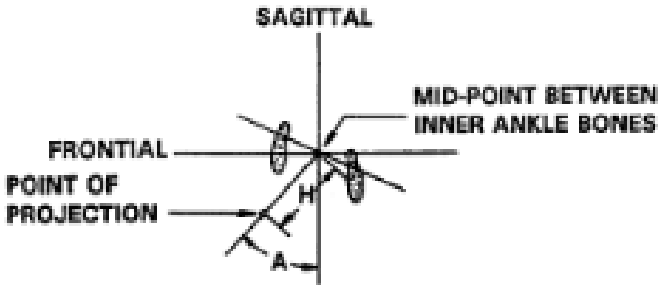
Vertical Location (V) Minimum of 0”, Maximum of 70” (175 cm)



Angle of Asymmetry

Asymmetric Angle (A) – Measure the degree to which the body is required to twist or turn during the lifting task. The asymmetric angle is the amount (in degrees) of trunk and shoulder rotation required by the lifting task.





Angle of Asymmetry

Coupling

Coupling (C) – Determine the classification of the quality of the coupling between the worker's hands and the object as good, fair, or poor (1, 2, or 3). A good coupling will reduce the maximum grasp forces required and increase the acceptable weight for lifting, while a poor coupling will generally require higher maximum grasp forces and decrease the acceptable weight for lifting.

Coupling

1 = Good - Optimal design containers with handles of optimal design, or irregular objects where the hand can be easily wrapped around the object.

Coupling

2 = Fair - Optimal design containers with handles of less than optimal design, optimal design containers with no handles or cut-outs, or irregular objects where the hand can be flexed about 90°.

Coupling

3 = Poor - Less than optimal design container with no handles or cut-outs, or irregular objects that are hard to handle and/or bulky (e.g. bags that sag in the middle).

Coupling

3 = Poor – A good coupling (left) can turn into a poor coupling (right) as a result of the handle style, as well a significant change in the vertical location of the hands.

Frequency

Frequency (F) - Determine the average number of lifts per minute for the lifting task being evaluated, this is the lifting frequency.

Minimum: 0.2 lifts/minute
Maximum: 15 lifts/minute

The Frequency (F) value will be between 0.2 lifts/minute and 15 lifts/minute. For lifting tasks with a frequency less than .2 lifts per minute (>1 lift every 5 minutes), you will use the minimum frequency of .2 lifts/minute.

The Frequency Multiplier (FM) value depends upon three variables: 1) the average number of lifts/min (F), 2) the vertical location (V) of the hands at the origin, and 3) the duration of continuous lifting.

Lifting above the maximum frequency results in a RWL of 0 and indicates an unsafe lifting condition.

Frequency

Special Procedure for Work Pattern Variation:
Frequently, the worker will not lift continuously for 15 minutes. For example, a worker might perform a lifting task at a rate of 7 lifts/minute for 10 minutes, and then perform light non-material handling work (such as paperwork) for 5 minutes to complete the 15-minute work cycle.

In this case you would calculate the total number of lifts in the entire 15-minute cycle (7 lifts/minute x 10 minutes = 70 lifts), and then divide this number by 15. So, the resulting calculation would be 7x10 = 70/15 or 4.66 lifts/minute.

So, to determine simply obtain or count the total number of lifts performed in a typical 15-minute period of time and divide that total number by 15 (if using a 15-minute sampling period).

Note: If the worker had lifted continuously for the entire 15 minutes at a rate of 7 lifts/minute, then the actual lifting frequency (7 lifts per minute) would be used.

Average and Maximum Load

Load (L) – Determine the weight of the object lifted. If necessary, use a scale to determine the exact weight. If the weight of the load varies from lift to lift, you should record the average and maximum weights lifted.

Duration

Duration (Dur) – Determine the lifting duration as classified into one of three categories: Enter 1 for short-duration, 2 for moderate-duration and 8 for long-duration as follows:

1 = Short - lifting ≤ 1 hour with recovery time ≥ 1.2 X work time

2 = Moderate - lifting between 1 and 2 hours with recovery time ≥ 0.3 X lifting time

8 = Long - lifting between 2 and 8 hours with standard industrial rest allowances

These categories are based on the pattern of continuous work-time and recovery-time.

A continuous work-time is defined as a period of uninterrupted work. Recovery-time is defined as the duration of light work activity following a period of continuous lifting. Examples of light work include activities such as administrative work, monitoring operations, light assembly work, etc.

Duration

1 = Short - lifting ≤ 1 hour with recovery time ≥ 1.2 X work time

Short duration includes lifting tasks that have a work cycle duration of 1 hour or less, followed by a recovery time of at least 1.2 times the work time. If the recovery time requirement is not met, and another lifting session is immediately required, then the total work time must be added together. If the total work time exceeds 1 hour, then the job must be classified as a moderate-duration lifting task.

Example: A worker performs lifting task continuously for 25 minutes, then performs light work tasks for 15 minutes, and then lifts for an additional 45-minute period. In this case, the recovery time between lifting sessions (15 minutes) is less than 1.2 times the initial 25-minute work time (25 min x 1.2 = 30 min). Therefore, the two work times (25 minutes and 45 minutes) must be added together to determine the duration. Since the total work time (70 minutes) exceeds 1 hour, the job is classified as moderate-duration.

Duration

2 = Moderate - lifting between 1 and 2 hours with recovery time ≥ 0.3 X lifting time

Moderate duration includes lifting tasks that have a duration of more than one hour, but not more than two hours, followed by a recovery period of at least 0.3 times the work-time. So If a worker continuously lifts for 2 hours, then a recovery period of at least 36 minutes (120 min x .3 = 36 min) would be required before initiating a subsequent lifting session. If the recovery time requirement is not met, and another lifting session is subsequently required, then the total work time must be added together. If the total work time exceeds 2 hours, then the job must be classified as a long-duration lifting task.

Example: A worker performs a lifting task continuously 90 minutes, then performs light work for 15 minutes, and then subsequently performs the lifting tasks for an another 90 minutes. In this case, the recovery time between lifting sessions (15 minutes) is less than .3 times the initial 90-minute work time (90 min x .3 = 27 min). Because the recovery time requirement is not met in this case, the two work times (90 minutes and 90 minutes) must be added together to determine the duration. Since the total work time (180 minutes) exceeds 2 hours, the job is classified as long-duration.

Duration

3 = Long - lifting between 2 and 8 hours with standard industrial rest allowances for lunch and rest breaks.

Note: No weight limits are provided for more than eight hours of work.

Outputs

RESULTS

Risk

Risk Index	2.36	3.64

	Origin	Destination
Recommended Weight Limit(RWL)	16.91	10.98
Frequency Independant RWL (FIRWL)	28.19	18.31
Lifting Index (LI)	2.36	3.64
Frequency Independent LI (FILI)	1.60	2.46

Multipliers

HM	1.00	0.50
VM	0.78	0.96
DM	0.87	0.87
AM	0.86	0.86
CM	0.95	1.00
FM	0.60	0.60

SAVE CANCEL

Outputs

RWL = LC (51) x HM x VM x DM x AM x FM x CM

Recommended Weight Limit (RWL)

Answers, “Is this weight too heavy for the task?”

Lifting Index (LI)

Answers, “How significant is the risk?”

> 1.0 High Risk
< 1.0 Nominal Risk

The goal is to design a job / task to be < 1.0!

Outputs

Frequency Independent Recommended Weight Limit (FIRWL)

Uses a Frequency Multiplier (FM) of 1.

Frequency Independent Lifting Index (FILI)

= Weight ÷ FIRWL