NIOSH Lifting Criteria Definitions

Percent Capable
The percent capable females and males are roughly estimated. A value of LI-1 assumes 75% of females and 99% of males capable per NIOSH Guide 1981. Similarly, a value of LI=3 assumes 1% of females and 25% of males capable per NIOSH Guide 1981. This analysis ignores tissue tolerance for compressive force in determining percent capable population. Based on compressive force the task or job may be hazardous to a much larger population than estimated.

As the Lifting Index increases, a greater percentage of the workforce is likely to be at risk of developing lower back pain due to lifting. However, the shape of the risk function is NOT linear. It is not possible to quantify the precise degree of risk associated with LI.

Definitions For

Asymmetric Angle (A)

\[ A = \text{The angle that asymmetry line marker from the mid-sagittal plane line (degrees).} \]

Asymmetry Line = Line joining the midpoint between the ankles with the midpoint of the hands projected on the floor.

Asymmetric Multiplier (AM)

\[ AM = (1 - .0032^o A) \]

0 Less than or Equal to (A) Less than or Equal to 135°

1. Use larger angles (A) at origin and destination.
2. If A > 135°, AM = 0
3. 0.57 Less than or Equal to AM Less than or Equal to 1
4. (4) At 90\(^\circ\), AM = 0.71

**Composite Lifting Index (CLI)**
1. The CLI reflects the overall physical demands of the entire job.
2. The CLI is computed as follows:
   - The tasks are renumbered in order of decreasing physical stresses, beginning with the task with the greatest STLI down to the task with the smallest STLI.

The CLI is computed according to the following formula:

\[
CLI = STLI (Task 1) + Increase\ in\ STLI\ due\ to\ Task\ 2 + Increase\ in\ STLI\ due\ to\ Task\ 3 + \ldots
\]

**Composite Recommended Weight Limit (CRWL)**
1. CRWL is the Recommended Weight Limit for the entire job.
2. This is the weight limit that none of the weights in the entire job should exceed if it is desired to keep the Composite Lifting Index (CLI) for the entire job within a value of 1.0.
3. If all tasks had weights equal to CRWL, this would result in CLI = 1.0.

CRWL is computed by setting CLI = 1.0 and solving for W (Weight of objects).

**Coupling (C)**

**Good**
- Length less than or equal to 16 in. (40 cm.); Height less than or equal to 12 in. (30 cm.); and good handles (or hand-hold cut-outs).
- Easy to handle loose parts and objects with wrap around grasp and without excessive wrist deviation.

**Fair**
- Length less than or equal to 16 in. (40 cm.); Height less than or equal to 12 in. (30 cm.); and poor handles (or hand-hold cut-outs).
- Length less than or equal to 16 in. (40 cm.); Height less than or equal to 12 in. (30 cm.), and 900 finger flexion.
- Easy to handle loose parts and objects with 900 finger flexion and without excessive wrist deviation.

**Poor**
- Length > 16 in. (40 cm.), or
- Height > 12 in. (30 cm.), or
- Difficult to handle parts, or
- Sagging objects, or
- Asymmetric center of mass, or
- Unstable contents, or
- Hard to grasp object, or
- Use of gloves
Criteria for Recommended Weight Limit

The RWL was developed using the following four criteria:

1. Compressive Force less than or equal to 770 lbs. (350 kg.)
2. Strength at least 75% females and 99% males are capable of performing the job at or below RWL.
3. Energy expenditure (E) should not exceed:
   a. Near the Floor: E less than or equal to 3.12 kcal/min.
   b. Bench Height: E less than or equal to 2.18 kcal/min.
4. Epidemiological: Nominal risk of overexertion injuries.

Frequency Independent Lifting Index (FILI)

FILI = (Maximum Weight for the task) /FIRWL

NOTE:

1. If a task has average and maximum weights, maximum weight is used to compute FILI. If the weight of the load does not change for a task, then average and maximum weights are the same.
2. FILI is computed when performing analysis of entire job (multiple-task analysis).

Frequency Independent Recommended Weight Limit (FIRWL)

FIRWL reflects the strength demands and/or compressive force produced from a single repetition (or occasional performance) of that task.

FIRWL is determined by using the respective task variables (H,V,D,A and C) and setting the Frequency Multiplier to a value of 1.0.

Frequency (F)

- F = Number of lifts/minute
- If F < 0.2 lifts/minute, F = 0.2
- Use frequency averaged over 15 minutes
- Add all the periods of lifting in one shift to determine duration
- Separately analyze high frequency and low frequency durations
- Maximum allowable frequency depends upon vertical location (V) and duration of lifting
- Work/Rest allowance must be considered

Maximum Allowable Frequency

<table>
<thead>
<tr>
<th>Lifting Duration</th>
<th>C &lt; 30 in. (75 cm.)</th>
<th>V greater than or equal to 30 in. (75 cm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1 Hour</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>1 to 2 Hours</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>2 to 8 Hours</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

Refer to the User’s Manual for Frequency Multipliers
Horizontal Location (H)
H = Horizontal Location (Inches, cm.) forward of midpoint between ankles and hands (center of grasp) at origin of lift.

OR

Horizontal distance from ankle (malleolus) to center of grasp (middle knuckle).
NOTE: If both hands or feet are not symmetrical, measure the horizontal distance for the right hand from the right ankle and the left hand from the left ankle.

H = (H right hand + H left hand)/2

Horizontal Multiplier
HM = (10/H) for inches or HM = (25/H) for centimeters
H is between 10 in. (25 cm.) and 25 in. (63 cm.)
1. If H < 10 inches (25 cm.), HM = 1
   If H > 25 inches (63 cm.), HM = 0

   It is strongly recommended that horizontal distance should be measured. If H cannot be measured, a rough estimate is desired. H can be estimated from the following equations.

2. If H = 8 + W/2 for V Greater than or Equal to 10 inches
   H = 10 + W/2 for V < 10 inches

Lifting Index (LI)
LI = Load Weight (lbs., kg.) / RWL (lbs., kg.)
• If LI is less than or equal to 1, the job is considered to be safe for most workers.
• The lower the value of LI, the safer the manual lifting job. For example, an LI of 0.7 is better than an LI of 0.9.

If LI is greater than 1, the job is unsafe for some workers. The greater the value of LI, the more unsafe the job is. For example, an LI of 3 is worse than an LI of 1.5.

Limitations of the Revised NIOSH Guide
The Revised NIOSH Guide is applicable only if the following conditions are satisfied.
• Two-handed, smooth, continuous lifting motion
• Unrestricted lifting posture
• Adequate foot traction
• Moderate ambient environment
• Object length does not exceed 25 in. or 65 cm.
• Smooth, continuous lowering motion can be treated as lifting
• Other manual handling activities are minimal
• No safety factor
Load Constant
The Load Constant for the Revised NIOSH Guide is:
51 lbs. or 23 kg.
- If the object weight is greater than 51 lbs. or 23 kg., LI will always be more than 1.
  51 lbs. or 23 kg. is the upper limit for manual lifting and lowering tasks to protect 75% of female workers under ideal lifting conditions.

Origin and Destination
Origin: Is where the lift or lower begins
Destination: Is where the lift of lower ends

All lifting and lowering tasks should be analyzed at the Origin only. However, if significant control is required to place the object at the Destination, then the lifting and lowering tasks should be analyzed both at the Origin and the Destination.

NOTE: The Weight of the Object (W), Travel Distance (D), Frequency (F), and the Duration of the lift are the same for the Origin and the Destination.
Horizontal Distance (H), Vertical Location (V), Asymmetric Angle (A), and Coupling (C) can be different at the Origin and the Destination of.

Rest Allowances (RT)
1. Duration less than or equal to 1 Hour
   RT (min.) = 1.2 x Work Time (min.)
2. Duration less than or equal to 2 Hours
   RT (min.) = 0.3 x Work Time (min.)
3. Duration less than or equal to 8 Hours
   No additional fatigue allowance other than normal allowances
   (Mid-morning Break, Lunch Break, Mid-afternoon Break)

Recommended Weight Limit (RWL)
RWL = Load Constant
X Horizontal Multiplier
X Vertical Multiplier
X Distance Multiplier
X Frequency Multiplier
X Asymmetric Multiplier
X Coupling Multiplier

1. None of the multipliers may have a value greater than 1.
2. If any of the multipliers have a value of zero, the value of RWL will be zero.

A NO LIFTING condition is recommended under these conditions.
Single Task Lifting Index (STLI)
1. STLI is the same as the LI for a simple task.
2. STLI = (Average Weight for the task) / STRWL
3. The STLI for a task reflects the overall physical demands of that task, assuming it was the only task being performed. This shows what would be the LI if all other tasks, except this task, were eliminated.

Single Task Recommended Weight Limit (STRWL)
1. STRWL is the same as the RWL for a simple task.
2. STRWL is computed by multiplying FIRWL for a task by the frequency multiplier (FM) for that task.
3. The STRWL for a task given the Recommended Weight Limit for that task, assuming it was the only task being performed. This shows what would be the RWL if all other tasks, except this task, were eliminated.

Vertical Location (V)
V = Vertical location of hands (inches, cm.) above the floor at origin (beginning) of lift

If the two hands are not at the same height, measure the vertical heights for both hands and take the average, i.e.,

V = (Vertical height for right hand + Vertical height for left hand)/2

Vertical Multiplier (VM)
If V is in inches:

VM = (1 - .00750 (IV - 30 I))

If V is in centimeters:

VM = (1 - .00300 (IV - 75 I))

- V cannot be less than 0 inches (0 cm.) or more than 70 inches (175 cm.)

Vertical Travel Distance (D)
D = Vertical travel distance (inches, cm.) of the hands between the destination (end point) and the origin (beginning) of lift or lower.

or

D = V at destination - V at origin

NOTE: For lowering tasks, D will be negative
**Distance Multiplier (DM)**

If $D$ is in inches:

$$DM = \left( .82 + \frac{1.8}{D}\right)$$

If $D$ is in centimeters:

$$DM = \left( .82 + \frac{4.5}{D}\right)$$

$D$ cannot be less than 10 inches (25 cm.) or more than 70 inches (175 cm.)

If $D < 10$ inches (25 cm.), $DM = 1$
If $D > 70$ inches (175 cm.), $DM = 0$