NIOSH WORK PRACTICE GUIDE FOR MANUAL LIFTING

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APPENDIX VII:1-2. EVALUATION OF LIFTING TASKS. [Completely Revised]

NIOSH WORK PRACTICE GUIDE FOR MANUAL LIFTING.

In 1981, NIOSH developed an equation to assess lifting conditions. In 1991, NIOSH issued a revised equation for the design and evaluation of manual lifting tasks. The 1991 equation uses six factors that have been determined to influence lifting difficulty the most, combining the factors into one equation. Two of the factors which are new to the revised equation include twisting (asymmetry) and the quality of the worker's grip on the load (coupling). Using the equation involves calculating values for the six factors in the equation for a particular lifting and lowering task, thereby generating a Recommended Weight Limit (RWL) for the task. The RWL is the load that nearly all healthy employees (90% of the adult population, 99% of the male and 75% of the female workforce) can lift over a substantial period of time (i.e., up to 8 hours) without placing an excessive load on the back.

The revised equation also incorporated a term called the Lifting Index, which is defined as a relative estimate of the level of physical stress associated with a particular manual lifting task. The estimate of the level of physical stress is defined by the relationship of the weight of the load lifted divided by the recommended weight limit. A level greater than one indicates that the lifted weight exceeded the RWL and should be addressed using either administrative or engineering controls. A level greater than three indicates that the lifted weight exceeds the capacity to safely lift for most of the population, is likely to cause injury, and should be modified by implementation of engineering controls.

The 1991 equation still maintains the 1981 biomechanical criteria for establishing the maximum lower back compression force of 770 lbs. For the revised equation, the load constant was reduced from 90 pounds to 51 pounds. This reduction was driven by the need to increase the minimum horizontal distance from 6 inches to 10 inches (which is believed to be the minimum attainable horizontal distance as measured from the spine during lifting) in the 1991 equation. Aside from this reduction the 1991 revised equation represents only a two-pound reduction from the 1981 version when adjusted for revised horizontal distance.

Application of the NIOSH lifting tasks assumes the following:

- Lifting task is two-handed, smooth, in front of the body, hands are at the same height or level, moderate-width loads (i.e., they do not substantially exceed the body width of the lifter), and the load is evenly distributed between both hands.
- Manual handling activities other than lifting are minimal and do not require significant energy expenditure, especially when repetitive lifting tasks are performed (i.e., holding, pushing, pulling, carrying, walking or climbing).
- Temperatures (66-79°F) or humidity (35-50%) outside of the ranges may increase the risk of injury.
- One-handed lifts, lifting while seated or kneeling, lifting in a constrained or restricted work space, lifting unstable loads, wheelbarrows and shovels are not tasks designed to be covered by the lifting equation.
- The shoe sole to floor surface coupling should provide for firm footing.
- Lifting and lowering assumes the same level of risk for low back injuries.
- Using the Guidelines in situations that do not conform to these ideal assumptions will typically underestimate the hazard of the lifting task under investigation.

The computed values of the Recommended Weight Limit are used by the CSHO as a guide to estimate risk. **The numbers by themselves** do not identify a hazardous activity. The employer's incidence of injuries and lack of programs for training, work practice controls, and engineering controls related to lifting are elements used to determine the seriousness of the hazard.

CALCULATIONS.

The revised lifting equation for calculating the Recommended Weight Limit (RWL) is based on a multiplicative model that provides a weighting for each of six variables:

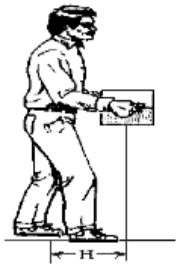
RWL = LC × HM × VM × DM × AM × FM × CM

where:

LC = Load Constant *(51 pounds)*

HM = Horizontal Multiplier *(10/H)*

FIGURE VII:1-1. HORIZONTAL MEASUREMENT.



Horizontal location of the hands (H): The horizontal location of the hands at both the start (origin) and end (destination) of the lift must be measured. The horizontal location is measured as the distance from the mid-point between the employee's ankles to a point projected on the floor directly below the mid-point of the hands grasping the object (the middle knuckle can be used to define the mid-point). The horizontal distance should be measured when the object is lifted (when the object leaves the surface).

VM = Vertical Multiplier *(1 - (0.0075|V-30|))*

Vertical location of the hands (V): 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).

DM = Distance Multiplier *(0.82 + (1.8 / D)*

Travel Distance of the load (D): The total vertical travel distance of the load during the lift is determined by subtracting the vertical location of the hands (V) at the start of the lift from the vertical location of the hands (V) at the end of the lift. For lowering, the total vertical travel distance of the load is determined by subtracting the vertical location of the hands (V) at the end of the lower from the vertical location of the hands (V) at the start of the lower.

AM = Asymmetric Multiplier *(1 - (0.0032A))*

Asymmetry Angle(A): The angular measure of the perpendicular line that intersects the horizontal line connecting the mid-point of the shoulders and the perpendicular line that intersects the horizontal line connecting the outer mid-point of the hips.

FIGURE VII:1-2. MEASURE OF ASYMETRY ANGLE A.

FM = Frequency Multiplier (See Frequency Table Below (Table VII:1-1))

Lifting Frequency (F): The average lifting frequency rate, expressed in terms of lifts per minute, must be determined. The frequency rate can be determined by observing a typical 15 minute work period, and documenting the number of lifts performed during this time frame. The number of lifts observed is divided by 15 to determine the average lifts per minute. Duration is measured using the following categories: **Short** (Less than one hour); **Moderate** (1 to 2 hours); **Long** (2 to 8 hours).

TABLE VII:1-1. FREQUENCY MULTIPLIER TABLE (FM) Frequency Lifts/min (F) ‡	Work Duration					
	< 1 Hour		> 1 but < 2 Hours		> 2 but < 8 Hours	
	V < 30 †	V > 30	V < 30	V > 30	V < 30	V > 30
< 0.2	1.00	1.00	.95	.95	.85	.85
0.5	.97	.97	.92	.92	.81	.81
1	.94	.94	.88	.88	.75	.75
2	.91	.91	.84	.84	.65	.65
3	.88	.88	.79	.79	.55	.55
4	.84	.84	.72	.72	.45	.45
5	.80	.80	.60	.60	.35	.35
6	.75	.75	.50	.50	.27	.27
7	.70	.70	.42	.42	.22	.22
8	.60	.60	.35	.35	.18	.18
9	.52	.52	.30	.30	.00	.15
10	.45	.45	.26	.26	.00	.13
11	.41	.41	.00	.23	.00	.00
12	.37	.37	.00	.21	.00	.00
13	.00	.34	.00	.00	.00	.00
14	.00	.31	.00	.00	.00	.00
15	.00	.28	.00	.00	.00	.00
> 15	.00	.00	.00	.00	.00	.00

† Values of V are in inches.
‡ For lifting less frequently than once per 5 minutes, set F = 2 lifts/minute.

CM = Coupling Multiplier **(See Coupling Table Below (Table VII:1-2))**

Object coupling (C): The classification of the quality of the hand-to-object coupling (rated as **Good, Fair**, or **Poor)**.

TABLE VII:1-2. COUPLING TABLE GOOD	FAIR	POOR
CM = 1.00	**V < 30" then CM = 0.95**	**CM = 0.90**
	V > or = to 30" then CM = 1.00	
1. For containers of optimal design, such as some boxes, crates, etc., a "Good" hand-to-object coupling would be defined as handles or hand-hold cut-outs of optimal design.	1. For containers of optimal design, a "Fair" hand-to-object coupling would be defined as handles or hand-hold cut-outs of less than optimal design.	1. Containers of less than optimal design or loose parts or irregular objects that are bulky or hard to handle.
2. For loose parts or irregular objects, which are not usually containerized, such as castings, stock, supply materials, etc., a "Good" hand-to-object coupling would be defined as a comfortable grip in which the hand can be easily wrapped around the object.	2. For containers of optimal design with no handles or hand-hold cut-outs or for loose parts or irregular objects, a "Fair" hand-to-object coupling is defined as a grip in which the hand can be flexed about 90 degrees.	2. Lifting non-rigid bags (i.e., bags that sag in the middle).

Help using the lifting formula is available through the Directorate of Technical Support and Emergency Management.

LIFTING ANALYSIS WORKSHEET TABLE.

The actual worksheet can be found in **Appendix VII:1-5**. The lifting analysis should be performed using both the average and maximum weights