



Week of October 7, 2013 – The NIOSH Lifting Equation

Back sprains and strains from tasks involving lifting continue to be one of the leading causes of occupational incidents. Standard lifting practices that are designed to reduce back injuries are typically specified in project health and safety plans, activity hazard analyses as well as during tailgate meetings. Such practices as “lift with your knees ó not your back,” and “use buddy lifting or mechanical devices when available” are common controls that are presented to field personnel to prevent back injuries.

Another practice that is frequently documented is the limit for manual lifting ó that is, 51 pounds. Many times this weight is listed as the maximum load such that, once this weight is reached, manual lifting is not an acceptable practice. Actually this weight limit ó 51 pounds ó is not so specific or clear-cut. Under *IDEAL* circumstances, 51 pounds (23 kilograms) has been established by the National Institute for Occupational Safety and Health (NIOSH), as the maximum load for which 75% of females and 90% of males may handle as an acceptable load (without compromising their physical ability).

According to NIOSH, the term, “ideal” with regards to the weight limit of 51 pounds is based on a very specific set of conditions and is actually the maximum value based on the NIOSH Lifting Equation shown below:

$$\mathbf{RWL = LC \times HM \times VM \times DM \times AM \times FM \times CM}$$

Where:

- RWL = Recommended weight limit (51 pounds under ideal conditions)
- LC = Load Constant (51 pounds)
- HM = Horizontal Multiplier (distance the load is held from the person (directly in front of the person))
- VM = Vertical Multiplier (vertical distance from the ground)
- DM = Distance Multiplier (distance the load must travel vertically from ground up or vice versa)
- AM = Asymmetric Multiplier (angular displacement from directly in front of the person)
- FM = Frequency Multiplier (number of times a lift/carry is performed in a 15-minute period)
- CM = Coupling Multiplier (this is a “gripping factor” quantifying how well a person can grab an object)

This equation can get quite involved as there are many variables (each one of the multiplier values has its own equation and therefore requires its own separate calculation). The simplest this equation gets (or ideal condition) is when all the multipliers equal one. This only happens

when the lifting task is optimal; that is, when the object is directly in front of the person (and within 10 inches), 30 inches off the ground, the travel distance is less than or equal to 10 inches, the object stays directly in front of the person (no deviation to either the left or right), while the lift rate is 0.2 lifts/minute (or 12 lifts/hour) and lasts no more than one hour, and a firm grip on the object can be demonstrated, all multipliers will equal 1 (unity); therefore the recommended weight limit (RWL) will be:

$$\text{RWL} = 51 \text{ pounds} \times 1 \times 1 \times 1 \times 1 \times 1 \times 1; \text{ which equals } 51 \text{ pounds!}$$

Should any of these conditions change, the affected multiplier(s) are modified to a value that is less than unity (i.e. a decimal value), resulting in a RWL less than 51 pounds.

The NIOSH Lifting Equation can be studied in more detail through the publication, *APPLICATIONS MANUAL for the REVISED NIOSH LIFTING EQUATION* (it is an easy *Google* search). Through an examination, there are a number of scenarios where a recommended weight limit would be equal to zero; which means, manual lifting is not recommended. An example where this would happen would be when the asymmetric multiplier is zero due to an action requiring a person to grab an object and place it in another location that requires rotating his/her body to an angle of more than 135 degrees (which can occur in assembly line type work or a work station where multiple parts need to be assembled in a specific order). Other examples where manual lifting is not recommended (due to a zero RWL) is when an object cannot be held at a distance within 25 inches from the body or when the carrying frequency exceeds 15 times per minute.

The NIOSH Lifting Equation is only one tool that can be used to help prevent work-related low back pain and disability. In fact, this equation while illustrating the many limitations of performing manual lifting under "acceptable" conditions, this equation cannot be used for many scenarios, such as: lifting/lowering with one hand, lifting/lowering for more than an 8-hour shift, lifting/lowering while seated or kneeling, lifting/lowering in a restricted space or handling unstable objects, moving at a pace faster than 30 inches per second (150 feet/minute of approx 1.7 mph) or working in unfavorable environments, such as temperature extremes and very humid or dry conditions.

Many of us that have heard about the NIOSH 51-pound manual lifting limit use this value as the load limit regardless of the many influencing factors (probably because such factors were never presented). In many cases, the RWL will be considerably less than 51 pounds, and therefore require other measures to lift and move equipment and materials. Something that should always be practiced before attempting any lift is to size the load to make sure you can handle it. If it seems that the load may be a little too much for one person, ask a buddy for help or use a mechanical device. Back sprains and strains are painful and can result in a lifetime of discomfort.

Safety is a cheap and effective insurance policy

OSHA Safety Slogan