

Purpose

This guidance sheet was designed to help employers identify and assess risks of musculoskeletal injury (MSI) due to pushing and pulling. WorkSafeBC's MSI [Worksheet A](#) and [Worksheet B](#) do not address exposure to pushing and pulling. However, for tasks that require two-handed horizontal pushing and pulling in a straight line, such as pushing a cart or a box along a floor, see WorkSafeBC's Push/Pull Calculator: <http://www2.worksafebc.com/ppcc/default.htm>.

In the Regulation

Section 4.48 of the Occupational Health and Safety Regulation states:

When factors that may expose workers to a risk of MSI have been identified, the employer must ensure that the risk to workers is assessed.

The rest of this guidance sheet will focus on the risk associated with pushing and pulling forces that do not involve the traditional tasks addressed by the Push/Pull Calculator. These non-traditional tasks include pushing up or down, pushing from side to side, or pulling down. For the purposes of this bulletin, these tasks are simply termed *pushing and pulling*.

Background

Pushing and pulling can increase the risk of injury to the arms, shoulders, or back. The risk of injury may come from a single traumatic event or from repetitive exertions over a long period of time.

Risk identification

Some occupations that may have exposure to pushing and pulling include trades, manufacturing, maintenance, and municipal work. If any jobs at your workplace require workers to forcefully push levers up or down, pull hoses or cables, push an object from side to side, and/or push up on heavy lids or shafts, these jobs must be assessed for risk of MSI.

Risk assessment

Direct measurement of forces using a push/pull dynamometer (a strain or force gauge) is a common method for assessing the risk of MSI. These values are *not* the same as the actual weight of the object being pushed or pulled, and are expressed in Newtons (N), pounds of force (lb f), or kilograms of force (kg f).

Consider the following points when determining the risk of MSI while pushing and pulling:

- Are workers pushing and pulling at heights above shoulder level or below knee height?
- Are workers reaching away from the body?
- Are workers' wrists bent or twisted?
- Are workers restricted or constrained in certain postures (e.g., seated or kneeling)?

- Do workers use only one hand?
 - Is the load awkward to push or pull?
 - Is there a lot of resistance?
 - Are loads pushed or pulled over long distances?
 - Are workers pushing and pulling repeatedly or for long periods of time?
- Answering yes to one or more of these questions indicates that there are risk factors present that increase the risk of MSI due to pushing and pulling.

Some research has been conducted to determine safe limits for pushing and pulling tasks based on maximal strength measurements. Unfortunately, as with many ergonomics exposures, there is no one universally accepted safe limit. There are few validated assessment tools that specifically address many of these non-traditional pushing and pulling tasks, so readers may need to refer to several sources of information to find safe limits for the particular task of interest.

The table below lists resources that provide limits for some of these non-traditional tasks.

Reference	Tasks
<i>Kodak's Ergonomics Design for People at Work</i>	<ul style="list-style-type: none"> • Pulling down from head and shoulder height • Pulling up from floor, elbow, and shoulder heights • Pushing down from elbow height • Boosting up from shoulder height
<i>A Guide to Manual Materials Handling</i>	<ul style="list-style-type: none"> • One-handed standing push • One-handed standing pulling
Department of Defense Design Criteria Standard Human Engineering MIL-STD 1472 <i>Note: it is advisable to refer to the 5th percentile female when using military standards for the working population.</i>	<ul style="list-style-type: none"> • Standing two or one-handed pull • Standing two or one-handed push • Seated one and two-handed pull • Pushing with the back and shoulder
BS EN 1005-3:2002 Safety of machinery – Human physical performance – Part 3: Recommended force limits for machinery operation	<ul style="list-style-type: none"> • Seated one arm push forward, upward, downward • Seated one arm push side to side • Seated one arm pull backward

Risk control

The employer is required to eliminate or minimize the risk of MSI to workers. Controls that can be implemented to reduce the risk of MSI due to pushing, pulling, and carrying force include:

- Eliminating the need to push or pull:
 - Automate pushing and pulling tasks (e.g., use powered rollers/conveyors or gravity feed systems).

- Use mechanical assistance such as powered tuggers, cable tuggers/pullers, forklifts, cranes, or vacuum lifts.
- Improve the process to eliminate unnecessary pushing and pulling.
- Reducing the forces required to push or pull:
 - Reduce the weight or size of the load.
 - Maintain equipment to ensure minimal forces are required to operate it.
 - Reduce friction between the object being pushed/pulled and its contact surface.
 - Where practicable, provide handles.
 - Wear appropriate footwear to enhance friction and minimize slippage between floor and shoes.
 - Minimize the distances over which objects are to be pushed or pulled (change the layout of the workplace if necessary).
- Optimizing working postures/technique:
 - Design tasks so that hands are positioned between knees and shoulders.
 - Push rather than pull. Pushing is usually less stressful on the body because you can use the weight of your body and maintain a more neutral posture.

In the Regulation

Section 4.50 (1) of the Occupational Health and Safety Regulation states:

The employer must eliminate or, if that is not practicable, minimize the risk of MSI to workers.

For an overview of pushing and pulling research, see the Health and Safety Executive Research Report 228 (UK, 2004).

Sources

Kodak's Ergonomics Design for People at Work (2nd edition). Eastman Kodak Company (2004). John Wiley & Sons, Rochester.

A Guide to Manual Materials Handling (2nd edition). Mital, A., Nicholson, A.S. and Ayoub, M.M. (1997). Taylor & Francis, London.

United States Department of Defense Human Engineering MIL-STD 1472.

British Standard BS EN 1005-3:2002 Safety of machinery – Human physical performance – Part 3: Recommended force limits for machinery operation.