

The Physical Job Evaluation Checklist User Guide



MANUFACTURING

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THE PHYSICAL JOB EVALUATION CHECKLIST

The Physical Job Evaluation Checklist allows the user to determine the level of risk (low, moderate and high) for developing work-related musculoskeletal disorders (WMSDs) of the back, shoulder, hand/wrist and knee. There are six Physical Job Evaluation Checklists, each specific to an industry. These industries are: Agriculture, Forestry & Fishing; Construction; Manufacturing; Wholesale and Retail Trade; Services (excluding Public Safety); and Health Care and Social Assistance.

This reference guide describes the Physical Job Evaluation Checklist for the Manufacturing industry.

Purpose

The intended purposes of the Physical Job Evaluation Checklist are to:

1. Increase general awareness of industry-specific physical factors that contribute to work-related musculoskeletal disorders (WMSDs).
2. Help identify specific aspects of the job that pose a risk for back, shoulder, hand/wrist and knee injury.
3. Help prioritize injury prevention efforts by identifying the jobs, or the aspects of the job that pose the greatest risk of injury.
4. Evaluate the impact that process changes have on WMSD risk (before and after exposures).
5. Compare exposures between workers performing the same or different tasks.

The Physical Job Evaluation Checklist **IS NOT** intended to predict the occurrence of a WMSDs or to provide guidance or suggestions on how to mitigate exposure to risk factors of WMSDs.

This reference guide will:

- Provide guidance in how to answer each question in the Physical Job Evaluation Checklist,
- Provide information regarding the determination of risk levels.

Features of the Physical Job Evaluation Checklist

The level at which a job is evaluated (the unit of analysis) is left to the user, affording some flexibility. This means the evaluation can look at an activity within a task, a task within a job or the entire job. In this checklist we refer to any unit of analysis as “the work”.

The Physical Job Evaluation Checklist does not have to be completed in its entirety. An evaluation can be done for a specific body part (back, shoulder, hand/wrist, knee) or a specific activity, like lifting or pushing or pulling.

WORK-RELATED MUSCULOSKELETAL DISORDERS (WMSDs)

The following sections describe work-related musculoskeletal disorders and the methods used to develop the Physical Job Evaluation Checklist. To learn how to use the checklist, proceed to the section [“Using the Physical Job Evaluation Checklist”](#).

Description

WMSDs are soft-tissue disorders of non-acute origin that are caused or exacerbated by the work environment. These are conditions of the nerves, tendons, muscles and supporting structures of the musculoskeletal system. WMSDs most frequently occur to the back, shoulders, neck, elbows, hands, wrists, hips and knees. These disorders are a result of workplace physical or psychosocial stressors put on the structures over time. WMSDs include, but are not limited to, carpal tunnel syndrome, tendinitis, tenosynovitis, bursitis, herniated discs, sciatica, epicondylitis, muscle strains and sprains and rotator cuff syndrome. Symptoms of WMSDs include general aching or discomfort, tingling, numbness, swelling, and pain.

WMSD Risk Factors

The physical workplace stressors, referred to as risk factors, widely considered to cause WMSDs include:

- Repetitive Motions
- Static Body Postures

- Awkward Body Postures
- Forceful Hand Exertions (excessive pinching or gripping)
- Hand/Arm Vibration
- Whole Body Vibration
- Manual Material Handling (lifting, pushing, pulling and carrying)

The development of WMSDs can result from exposure to a single or multiple risk factors.

Research has found that exposure to a combination of physical risk factors increases the risk of WMSDs.

Three dimensions of these risk factors are used to determine WMSD risk level:

1. How often? (Frequency)
2. For how long? (Duration)
3. How hard? (Intensity)

In the United States, in 2015, WMSDs accounted for 31% of the occupational injuries and illnesses that required days away from work. The median number of days away for WMSDs in private industry, a measure of severity of injury, was 12. This compares to a median of 8 days away from work for all injuries and illnesses. In Washington State, between 2010 and 2015, WMSDs accounted for approximately 39% of workers' compensation claims, resulting in an estimated \$16 billion in direct workers' compensation costs.

DEVELOPMENT OF THE PHYSICAL JOB EVALUATION CHECKLIST

Background

The Physical Job Evaluation Checklist was developed as part of a five-year study on work-related musculoskeletal disorders in Washington State industries conducted by the Safety and Health Assessment for Research and Prevention (SHARP) Program. The Physical Job Evaluation Checklist was developed using data quantifying the exposure to physical risk factors for WMSDs from companies recruited across Washington State.

Participating companies in the Manufacturing industry were classified as the following:

- Cut Stock, Resawing Lumber, and Planing
- Sawmills
- Sheet Metal Work Manufacturing
- Fabricated Structural Metal Manufacturing
- Unsupported Plastics Profile Sharp Manufacturing
- Ornamental and Architectural Metal Work Manufacturing
- All Other Miscellaneous Wood Product Manufacturing – establishments primarily engaged in manufacturing wood products, excluding sawmills and preservation facilities, veneer, engineered wood products, millwork, manufactured homes, prefabricated buildings
- All Other Plastics Product Manufacturing – establishments primarily engage in manufacturing plastics products excluding film, sheet, bags, pipes, pipe fittings, laminates, foam products, bottles plumbing fixtures

Methods

Exposure to physical risk factors of WMSDs was evaluated through direct observations and interviews, using seven existing job assessment tools that are widely utilized by health and safety professionals and researchers. These job assessment tools were:

1. Washington State's Caution Zone and Hazard Zone Checklist ^{4,5}
2. The Strain Index ³
3. The American Conference of Governmental Industrial Hygienist (ACGIH) Lifting TLV ⁹
4. Thomas Bernard Tables based on the Liberty Mutual Manual Material Handling Guidelines (1991) ^{6,7}
5. The Quick Exposure Check^{1,2}
6. The European Union Hand-Arm Vibration Guidelines⁸
7. The European Whole-Body Vibration Guidelines⁸

Each industry-specific evaluation checklist is comprised of elements from these different assessment tools. These assessment tools were used to quantify the exposure to defined risk factors of WMSDs. The results were then used to describe the risk of developing WMSDs. The checklist was developed to be as protective as possible, meaning those elements of the various job assessments tools that most frequently identified high risk levels were chosen for inclusion in the Physical Job Evaluation Checklist. The job assessment tool elements that were included in the **Manufacturing** industry specific checklist can be found in [Appendix One](#).

Some of the above assessment tools stratified risk on four levels (low, moderate, high and very high) while others used three levels (low, moderate and high). To avoid confusion about the highest possible risk level, for the checklist items where four levels of risk were defined, the two highest categories (high, very high) were combined into one (high).

The following table describes the risk factors assessed for each body part of focus:

BACK	SHOULDER	HAND/WRIST	KNEE
Awkward Postures	Awkward Postures	Forceful Hand Exertions	Kneeling
Carrying	Carrying	Hand Activity	Squatting
Manual Lifting	Manual Lifting	Hand/Arm Vibration	Repetitive Foot Motions
Pushing/Pulling	Pushing/Pulling	Repeated Impacts	Whole Body Vibration
Work Pace	Work Pace	Repetitive Motions	Work Pace
Work Stress	Work Stress	Work Pace	Work Stress
Whole Body Vibration		Work Stress	

The risk factors evaluated in the Physical Job Evaluation Checklist were restricted to those risk factors assessed by the existing job assessment tools. The definitions of the risk factors were the same as those used in the original assessment tools. Because of this, the checklist might not evaluate some physical factors that may increase the risk of WMSDs of the back, shoulder, hand/wrist and knee. These can include:

- Walking up and down ladders or stairs
- Walking on uneven surfaces
- Working in cold temperatures
- Working in wet conditions

- Prolonged standing in one place without the ability to move about.
- Prolonged sitting without the ability to get up

USING THE PHYSICAL JOB EVALUATION CHECKLIST

Checklist Download

The checklist can be downloaded from:

<http://www.lni.wa.gov/Safety/Research/Wmsd/WMSD2010.asp>

The minimum system requirements are:

- Microsoft Excel: this is an Excel file (.xlsm), 4 MB in size.
 - The checklist cannot be used with other spreadsheet programs.
- Microsoft Windows operating system only:
 - Running this file in other operating systems will create errors.

Completing the Checklist

To evaluate the work using the Physical Job Evaluation Checklist, follow these steps:

1. Open the program and select an industry.
2. Print and complete the paper form ([see example of paper form below](#)).
3. Observe the work and record exposures on the paper form.
4. Transfer the data from the paper form to the Electronic Checklist ([see example of checklist below](#)).
5. Review the results page.

The Electronic checklist is comprised of three parts:

1. The Tutorial: Provides the basics of navigating the checklist.
2. Data Entry Pages: Exposure data from the paper form are entered here.
3. The Results Report: Presents the final summary results arranged by body parts and other details.

This checklist can be completed by one person or by group consensus. It is recommended that at least one user has a basic knowledge of workplace injury prevention, job evaluation and physical hazards.

Although this checklist is intended to be relatively quick and easy and does not require an extensive observation period, a more detailed, in-depth evaluation can be accomplished by observing the work over the course of the day or multiple days. When evaluating the work, consider seasonal or temporal shifts in the work, with respect to either the job demands or the activities performed.

This checklist is designed so that the work to be evaluated is determined by the user. This checklist can be used to evaluate a single work activity of the “job”, multiple activities or the entire job.

There are different methods of gathering exposure data to complete assessments:

- Method 1: Observe one worker as a representative for all the workers.
- Method 2: Observe several workers and record the most common scenario among them.
- Method 3: Observe several workers and record the worst case scenario among them.

USING THE PHYSICAL JOB EVALUATION CHECKLIST RESULTS TO REDUCE OR ELIMINATE WMSD RISK

The Physical Job Evaluation Checklist may be used in several ways to help workplaces in their WMSD injury prevention efforts.

1. The Checklist identifies the risk for each WMSD risk factor by level (highest to lowest). This will help workplaces prioritize prevention efforts.
2. The unit of analysis (job, task, activity) of the Checklist is determined by the user, so high risk jobs within a single department or high risk activities within a job may be identified.
3. The Checklist may be used to evaluate work activities that should be avoided for return-to-work or work restriction situations.

4. The Checklist may be used to determine the impact of proposed injury prevention solutions by comparing current exposure levels to potential exposure levels.
5. The Checklist may be used to identify how components of a risk factor (frequency, duration, intensity) may be changed to reduce the risk level. This provides insight into what potential prevention solutions should target.

Control Strategies

Once risk factors are identified and level of risk is determined, strategies should be identified to reduce or eliminate exposure to the WMSD risk factor. There are different types of risk factor controls:

1. Engineering Controls

Physical changes are made to the workplace, eliminating or reducing the magnitude, frequency and/or duration of the risk factors.

- This is the most desirable control strategy.
- Examples include installing a machine to do the work, changing processes so the risk factor is no longer present, using a tool to reduce risk factor exposure when performing the work.

2. Administrative Controls

Changes are made in the way work is assigned or scheduled, reducing the magnitude, frequency or duration of exposure.

- Examples include job rotation and job enlargement.

3. Work Practice Controls

This may include training workers on the best ways of performing a job without creating risk factors such as awkward postures.

4. Personal Protective Equipment (PPE)

Equipment is worn by workers to minimize exposures to risk factors that lead to WMSDs.

- This will reduce the magnitude of exposure but not the frequency or duration of exposure.

- Examples include vibration dampening gloves, impact reducing gloves, anti-fatigue matting, anti-fatigue insoles.

Carefully consider prevention efforts to ensure that implementing changes to eliminate or reduce exposure to one risk factor does not create or increase exposure to another risk factor or to another body part.

LIMITATIONS OF THE PHYSICAL JOB EVALUATION CHECKLIST

In the current version of the Physical Job Evaluation Checklist there are several limitations:

1. The Physical Job Evaluation Checklist DOES NOT predict the occurrence of a WMSD.
2. The Physical Job Evaluation Checklist does not provide suggestions, solutions or industry best practices to reduce or eliminate the presence of WMSD risk factors.
3. The exposure data for this industry, from which the checklist was developed, were collected from observed jobs in a limited number of industry sub-groups. Jobs in other unobserved industry sub-groups may have different exposures that may complicate the job evaluation.
4. At this time, the data in the electronic form cannot be saved. Electronic data entry must be completed in one sitting.

THE ELECTRONIC PHYSICAL JOB
EVALUATION CHECKLIST

- The Basics -

The Home Page

The checklists for all industries are included in one file. The Home Page allows the user to select the appropriate industry for the work being performed and to access the paper and electronic data entry forms.

After downloading the Physical Job Evaluation Checklist and opening the file:

1. Click on the SELECT INDUSTRY button and choose your industry. The selected industry will be displayed in the banner below the Home Page title.

HOME PAGE
MANUFACTURING

SHARP
Safety & Health Assessment & Research for Prevention

Welcome to the Physical Job Evaluation Checklist!

This checklist is intended to help the user determine the level of risk of developing work-related musculoskeletal disorders and injuries (WMSDs) through the observation and measurement of the work performed. Users of the checklist will be able to identify high risk jobs and be able to prioritize injury prevention efforts. This checklist can also be used to evaluate injury prevention solutions by comparing pre- and post-solution results. This tool cannot, however, predict injury or provide specific suggestions or solutions for reducing risk.

INSTRUCTIONS

- 1 Select the industry sector you are working with by clicking **SELECT INDUSTRY**.
- 2 To collect observational data, begin by clicking **PRINT PAPER FORM**.
- 3 Print a copy of the form for each job/task you plan to assess.
- 4 Observe the work performed by the worker as you fill out each page of the form.
- 5 After completing the form, return to this screen, select your industry, and click **LAUNCH CHECKLIST**.
- 6 Transfer your information from the paper form to the fields in the electronic checklist.
- 7 For some sections of the checklist, certain fields are required to calculate risk. However, you are not required to complete all sections.
- 8 Based on the results of the job report, consider ways you can change work practices and improve processes at your organization in order to minimize worker risk.

SELECT INDUSTRY **PRINT PAPER FORM** **LAUNCH CHECKLIST**

Developed in Excel 2010 for Windows. Other versions may cause errors.
Recommended screen resolution is 1920x1080.

Ver. 1.0, September 2016

Washington State Department of Labor & Industries

Industry Sector

Select industry sector:

- AGRICULTURE
- CONSTRUCTION
- HEALTH CARE
- MANUFACTURING**
- SERVICES
- WHOLESALE/RETAIL

2. Print the paper form by clicking on the PRINT PAPER FORM button.

HOME PAGE
MANUFACTURING

Job Basics

Observations made by: _____ Date: _____

Describe the work (job, task, or activity) being performed that you are evaluating (referred to hereafter as the "work"):

WORK DURATION —
On average, how much time is spent per day performing this work?

Less than 2 hours
 2 to 4 hours
 More than 4 hours

MAXIMUM WEIGHT HANDLED —
Is the maximum weight handled MANUALLY BY THE WORKER in this work:

Light (11 lbs. or less)
 Moderate (12 to 22 lbs.)
 Heavy (23 to 44 lbs.)
 Very heavy (more than 44 lbs.)

PACE OF WORK —
Does the worker find it difficult to keep up with this work?

Never
 Sometimes
 Often

WORK RELATED STRESS —
In general, does the worker find this work:

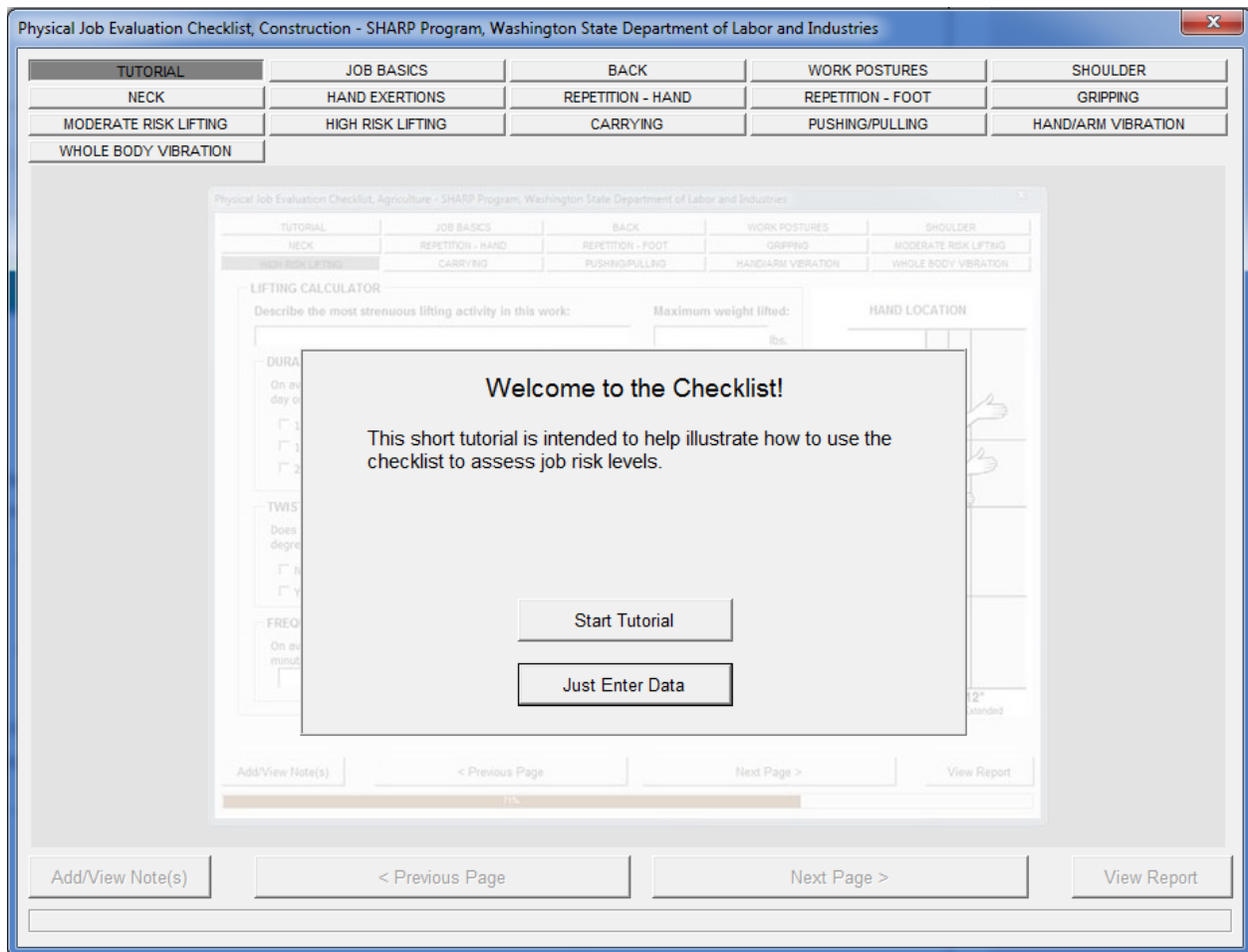
Not at all stressful
 Mildly stressful
 Moderately stressful
 Very stressful

NOTES:

Page 1 of 13

3. After recording the exposure data on the paper form, return to this page and click on LAUNCH CHECKLIST to enter the data into the electronic form.

The Tutorial



After clicking on the LAUNCH CHECKLIST button, a tutorial will guide the user through the various features of the checklist, including:

- Navigation through the checklist.
- The tabs across the top of the page.
- The functionality of the buttons on the bottom of each checklist tab page.
- Descriptions of the different features of the checklist that ensure that all necessary data are entered in order to determine a risk level.


To by-pass the tutorial, simply click on the JUST ENTER DATA button. You can exit the tutorial at any point by clicking the ENTER DATA button.

The Results Report

The Report Page is where the results of the job risk evaluation are presented.

REPORT

MANUFACTURING



PRINT THIS REPORT	EXPORT THIS REPORT	HOME PAGE	START A NEW JOB	BACK TO DATA ENTRY
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Work evaluated: Punch Press **Completed by:** SHARP Program
Analyzed on: 4/10/2017

Manual Material Handling Limits

- Based on the data entered, LIFTING objects weighing 19.8 lbs. or more will pose a high risk.
- Carrying limit (Not applicable, or insufficient data provided)
- Based on the data entered, PUSHING/PULLING objects with a force of 41.8 lbs. or more will pose a high risk.

Overall Work Environment

- Work-related stress poses a moderate risk for developing musculoskeletal disorders.
- Pace of Work poses a low risk for developing musculoskeletal disorders.

Back

- Back posture poses a high risk of injury.
- Lifting poses a moderate risk of injury.
- Pushing/Pulling poses a low risk of injury.
- Whole body vibration poses a low risk of injury.
- Carrying (Not applicable, or insufficient data provided)

Shoulder

- Shoulder posture poses a high risk of injury.
- Neck posture poses a moderate risk of injury.
- Lifting poses a moderate risk of injury.
- Pushing/Pulling poses a low risk of injury.
- Carrying (Not applicable, or insufficient data provided)

Hand/Wrist

- Pinch gripping poses a high risk of injury.
- Hand exertion poses a high risk of injury.
- Power gripping poses a low risk of injury.
- Typing/keying poses a low risk of injury.
- Hand-arm vibration poses a low risk of injury.
- Hand impact (Not applicable, or insufficient data provided)

Knee

- Kneeling poses a low risk of injury.
- Squatting poses a low risk of injury.
- Foot control(s) poses a low risk of injury.

Learn more about WMSDs at the SHARP website	Give your feedback and help us improve
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The Report Page has three parts:

1. Page 1: Evaluation of risk levels for each risk factor, based on the data entered. Risk factors are grouped by body part.
2. Page 2: Summary of all the exposure data entered that was used to determine risk levels.
3. Page 3: All notes that were inputted during data entry.

Results Report - Page 1

Manual Material Handling Limits

1. This section displays the maximum weight limit, based on the data entered. Manual handling more than this weight limit poses a high risk of injury.
2. A maximum weight limit of 0.0001 lbs signifies that there is no safe weight limit established based on the data entered.


Overall Environment, Back, Shoulder, Hand/Wrist, Knee Sections

1. These sections display the level of risk posed by different WMSD risk factors to specific body areas (back, shoulder, hand/wrist, and knee).
2. The level of risk is highlighted by a different color:
 - Green: Low risk
 - Orange: Moderate risk
 - Red: High risk
3. Within each section, the risk factors are presented from highest to lowest risk. This can help you prioritize injury prevention efforts.
4. "Insufficient Data/Not Applicable": This means that either no data are entered for this risk factor (it is not applicable to the work analyzed) or exposure data necessary to determine risk levels are missing.

Results Report - Page 2

Page 2 displays the exposure data that was entered into the electronic form.

Sections that are not applicable to a specific industry will stay blank.

Physical Job Evaluation DATA			
This page contains all the data used in the calculations which generated the above report.			
Observations Made By: SHARP Program		Date: 4/10/2017	
Job Basics	Work Description	Punch Press	
	Work Duration	More than 4 hours per day	
	Max Weight Handled	Heavy (23 to 44 lbs.)	
	Pace of Work	Never difficult to keep up	
	Stress	Mildly stressful	
Back	Back Position	When seated or standing: mostly stationary	
	Back Activity	Almost neutral	
Hand/Neck	Hand Position	At about chest height	
	Shoulder Movements	Frequent (regular movement)	
	Neck Bending	Flexed more than 30 degrees, more than 2 hours/day	
Work Posture	Squatting	None, or less than 2 hours per day	
	Kneeling	None, or less than 2 hours per day	
Hand Activity	Hand Exertions	Handling Parts	
	Daily Duration	>4 to <8 hours/day	
	Speed	Fast: rushed, but able to keep up	
	Frequency	4-8 per minute	
	Exertion Duration	10-29% of the time	
	Force	Somewhat hard: noticeable or definite effort	
	Posture	Bad: marked wrist bending	
Repetition	Forceful Hand Impacts		
	Foot Controls	≤2 hours a day, or none	
	Intensive Keying	No, does not involve intensive typing or keying.	
	Typing Duration	N/A	
	Typing Wrist Posture	N/A	
Griping	Pinch Grip Duration	6.5 hours total per day	
	Additional Risk Factors	-Wrist flexion > 30°	
	Power Grip Duration	1.5 hours total per day	
	Additional Risk Factors	N/A	
Moderate Risk Lifting	Lifting > 75 lbs.		
	Lifting > 55 lbs.		
	Frequent Lifting		
	Awkward Lifting		
Lifting	Lifting Activity	Lifting parts	
	Weight Lifted	25 lbs.	
	Duration	More than 2 hrs	
	Frequency	1 minute	
	Proximity	<12 inches away	
	Hand Height	mid-shin to knuckle height	
Carrying	Carrying Activity		
	Maximum Weight		
	Distance		
	Elbow Posture		
Pushing/Pulling	Frequency		
	Push/Pull Activity	Pushing pallet of parts	
	Effort Type	Push	
	Maximum Force(s)	35 lbs.	
	Distance	>11 to 150 feet	
	Hand Height	Hip	
	Frequency	30 minutes	
Vibration	Vibrating Hand Tools	Less than 1 hour per day, or Never	
	Whole Body Vibration	Less than 2 hours per day	
Total Vibration:			

Results Report - Page 3

Page 3 displays any notations that are typed into the electronic form.

Headings are automatically created to keep notes separated by the sections of the electronic form.

JOB BASICS:

- Job Basics 1
- Job Basics 2
- Job Basics 3

BACK:

- Back 1
- Back 2
- Back 3

SHOULDER:

- Shoulder 1
- Shoulder 2
- Shoulder 3

NECK:

- Neck 1
- Neck 2
- Neck 3

WORK POSTURES:

- Kneel/Squat 1
- Kneel/Squat 2
- Kneel/Squat 3

HAND EXERTIONS:

- Hand Exertions 1
- Hand Exertions 2
- Hand Exertions 3

REPETITION - HAND:

- Hand Repetition 1
- Hand Repetition 2
- Hand Repetition 3

GRIPPING:

- Gripping 1
- Gripping 2
- Gripping 3

LIFTING:

- Lifting 1
- Lifting 2
- Lifting 3
-

PUSHING/PULLING:

- Push/Pull 1
- Push/Pull 2
- Push/Pull 3

Page 3

INTERPRETING
CHECKLIST QUESTIONS

Job Basics

- An evaluation can look at an activity within a task, a task within a job or the entire job. In this checklist we refer to any unit of analysis as “the work”.

General Measurement Guidelines

1. Work Description: Describes the work (job, task, or activity) to be evaluated for risk of injury, also called the unit of analysis. This can be any description determined by the user.
 - The unit of analysis (the segment of work evaluated for WMSD risk) is determined by the user.
2. Work Duration: The amount of time per day the worker spends performing the work (job/activity/task) being assessed.
3. Maximum Weight Handled: The worker’s perception of the weight of the load specifically borne by the worker, not the actual weight being handling.
 - The actual weight is only used as a supplement but not as a replacement for the worker’s assessment.
4. Pace of Work: Rates how difficult it is for the worker to keep up with the work.
 - Responses are based on the worker’s perception.
 - The evaluation can be based on the physical difficulty or the self-imposed expectations of the worker in managing the workload.
5. Work-Related Stress: Rates the level of work-related stress felt by the worker. Studies have shown that:
 - Work-related stress is an important factor in the development of WMSDs (Bongers et al, 2002).
 - A worker’s subjective assessment of a potential risk factor is considered crucially important (Rydstedt et al, 2004).

Risk Level Definitions

Risk Factor	Risk Levels Based on Calculated Scores		
	Low	Moderate	High
Pace of Work	1	4	≥ 9
Stress	1	4	≥ 9

The Back

- These questions assess the posture of the lower back for the risk of injury.
- The evaluation is performed when the back is most heavily loaded (most extreme posture).

General Measurement Guidelines

1. Back Position (Figure One): In addition to flexion (back bent forward), twisting and side bending should also be considered.
2. Back Activity: Back activity is divided into static and dynamic back activity.
 - Static back activity: Bent or twisted back positions that are held over time.
 - Dynamic back activity: Bending or twisting the back (constant motion) when performing manual material handling activities, such as lifting, pushing/pulling or carrying.

Risk Level Definitions

Risk Factor	Risk Levels Based on Calculated Scores		
	Low	Moderate	High
Static Back Postures	8-14	16-22	≥ 32
Dynamic Back Postures	10-20	22-30	≥ 32

Checklist Definitions

Back Posture (Figure One):

- Almost Neutral Back Posture: 0-20° of flexion, twisting, or side bending.
- Moderately Flexed, Twisted or Side Bent Back Posture: 21-60° of flexion, twisting, or side bending.
- Excessively Flexed or Twisted or Side Bent Back Posture: >60° of flexion, twisting, or side bending.

Back Movement:

- Infrequent Back Movement: In the range of 1-5 movements per movement (mid-point: 3 times/minute or less).
- Frequent Back Movement: In the range of 6-10 movements per minute (mid-point: 8 times/minute).
- Very Frequent Movement: More than 10 movements per minute (around 12x/minute or more).

Figure One. Back Flexion Postures

Back Flexion, 20°



Back Flexion, 60°



Lateral Flexion, 20°



Lower Extremities (Kneeling, Squatting)

- Many disorders of the knee occur through the direct compression of the body tissues.
- Studies have shown a link between kneeling and/or squatting and low back disorders.
- Knee disorders are associated with squatting and with heavy physical work.
- Prolonged kneeling may cause reduced blood flow to the lower extremities.

Checklist Definitions

Kneeling: Supporting the body weight on either one or both knees.

Squatting: Crouching with the knees bent and the heels close to or touching the buttocks of the back of thighs.

Risk Level Definitions

Risk Factor	Risk Levels Based on Daily Duration of Exposure		
	Low	Moderate	High
Kneeling	≤ 2 hours	> 2 hours	> 4 hours
Squatting	≤ 2 hours	> 2 hours	> 4 hours

The Shoulder

- Shoulder elevation is a risk factor for WMSDs in the shoulder.
- The load on the muscles of the shoulder increases as the arms are raised higher.
- The risk of shoulder WMSDs is assessed when the shoulders/arms are most heavily loaded (most extreme posture).

General Measurement Guidelines

1. Hand Position: Shoulder posture is based on the position of the hands.
 - The worst or most extreme posture should be chosen.
2. Shoulder Movements: Consider any continuous movement of the shoulder, not just repetitive, cyclical actions.
 - Based on the worker's perceptions about the movement pattern of the shoulder, not the number of movements within a given period of time.

Risk Level Definitions

Risk Factor	Risk Levels Based on Calculated Scores		
	Low	Moderate	High
Awkward Shoulder Postures	10-20	22-30	≥ 32

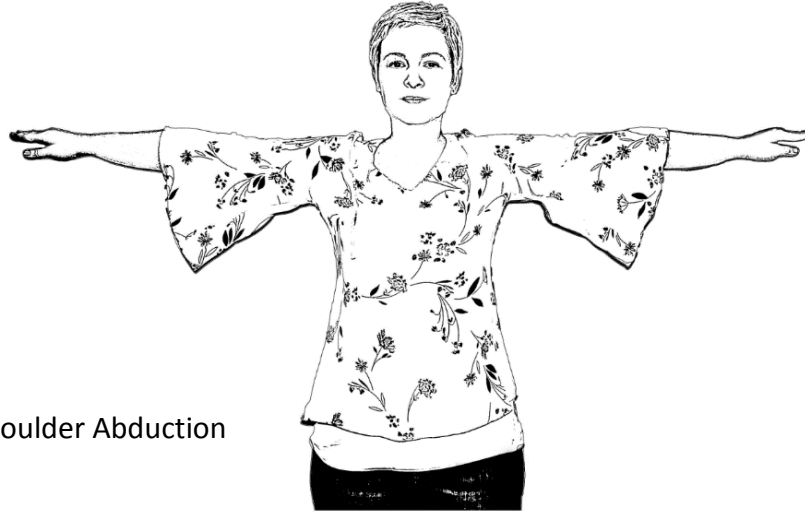
Checklist Definitions

Shoulder Postures: Non-neutral postures, where arms are elevated away from the sides of the body. Consider shoulder elevation in all planes ([Figure Two](#)).

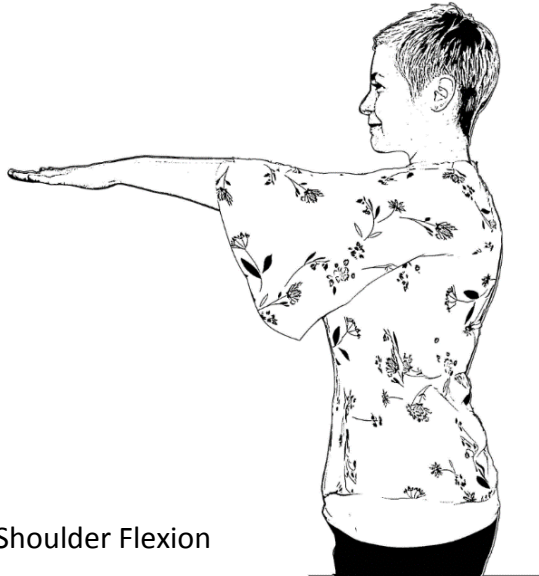
Static Shoulder Postures (static loading): Physical exertions in which the same posture or position is held throughout the exertion.

Dynamic Shoulder postures: Physical exertions created by the movement of the shoulder.

Figure Two. Shoulder Postures:



Shoulder Abduction



Shoulder Flexion

The Neck

- Non-neutral neck postures held for prolonged periods of time are a risk for neck and/or shoulder problems.

General Measurement Guidelines

1. Consider neck flexion that is a regular and foreseeable part of the job.
2. Consider neck flexion where there is no ability to vary from the posture or the posture is held without support.
3. Consider **only** the time that is spent in the specific posture and not the time spent in the job, task or activity.

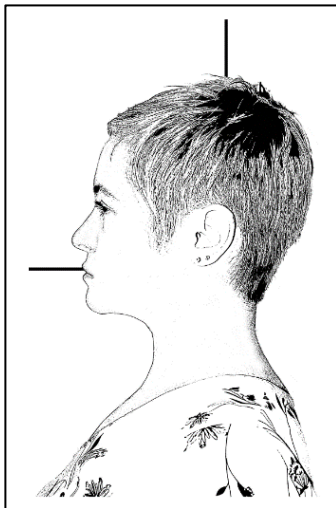
Risk Level Definitions

Risk Factor	Risk Levels Based on Daily Duration of Exposure		
	Low	Moderate	High
Awkward Neck Postures	Neck bent ≤ 2 hours per day	Neck bent $> 30^\circ$ for more than 2 hours per day	Neck bent $> 45^\circ$ for more than 4 hours per day

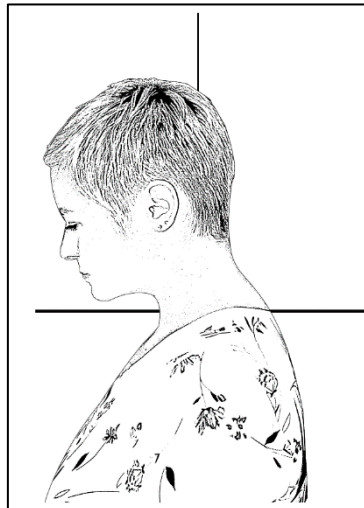
Checklist Definitions

Neck Bending: Considers flexed neck postures.

- Flexion – head bent forward, chin pointed down.



Neutral Neck Position



Neck Flexion, 30°



Neck Flexion, 45°

Hand Exertions

- These questions assess the risk of WMSDs of the hand, wrist and elbow from the activity of the hands.
- You may assess only one type of hand exertion or all hand exertions collectively.
- Considers several factors that contribute to risk:
 - The duration that the hand activities occur.
 - The speed at which the hands must exert force.
 - The frequency at which hand exertions are performed.
 - Duration of the actual hand exertions.
 - The level of force exerted by the hands.
 - The posture of the wrist when the hand exertions are performed.

General Measurement Guidelines

1. Duration of Task per Day: The total time the work is performed per day.
 - Expressed in hours.
2. Speed of Work: Indicates the perceived pace of the work performed.
 - Determined by the checklist user.
 - Imposes a modifying effect on exertion.
3. Frequency: Reflects the repetitiveness of the hand exertions.
 - The number of hand exertions that occurs during an observation period.
 - The observation period may be the duration of an activity, multiple activities, a task or the entire day.
4. Duration of Exertion: Estimates how long hand efforts/exertions are held over a period of time.
 - Also referred to as duty cycle.
 - Expressed as a percentage of time spent performing hand exertions during an observation period.

- The observation period may be the duration of an activity, multiple activities, a task or the entire day.
5. Hand Force: Estimates the hand force applied during the exertions/efforts.
- Reflects the muscular effort required.
 - The most critical aspect of hand activity to consider – increasing levels of muscular effort implies increasing levels of strain on the hand, wrist and elbow.
6. Hand/Wrist Posture: Characterizes the deviation of the wrist from the [anatomical neutral posture](#).
- Posture is determined qualitatively, not quantitatively.
 - Use the most common, the average, or the most extreme wrist posture.
 - Choosing the most extreme (worst) wrist posture will result in the most protective evaluation.

Risk Level Definitions

Risk Factor	Risk Levels Based on Calculated Scores		
	Low	Moderate	High
Hand Exertions	≤ 3	4-6	≥ 7

Checklist Definitions

Speed of Work:

- Very fast: The observed worker(s) either does not or barely manages to keep up with the required pace of the job, usually associated with relatively high rating for efforts per minute.
- Fast: The observed worker(s) is not overtly rushed but rely on deliberate action; also likely to have high efforts-per-minute ratings.

Frequency: Expressed as the number of hand efforts per minute

$$\text{Efforts per minute} = \frac{\text{number of exertions}}{\text{Total observation time}}$$

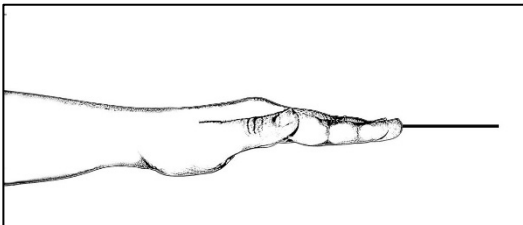
Duration of exertion

- Hand Exertion: When the hand force is first applied to when the hand force is released; can include pinching, gripping, squeezing, cutting, pressing, etc.
- Duration of Exertion: The duration of all exertions during an observation period divided by the total time of the observation period.

$$\% \text{Duration of exertion} = \frac{\text{duration of all exertions}}{\text{Total observation time}} \times 100$$

Hand/Wrist Posture

- Neutral Wrist Posture



Hand Repetition – Intensive Keying

- These questions evaluate the risk of hand/wrist WMSDs from intensive keying or prolonged data entry – prolonged, continuous data entry or keying activities.
- The risk of injury is increased when intensive keying is combined with awkward wrist postures.

Checklist Definitions

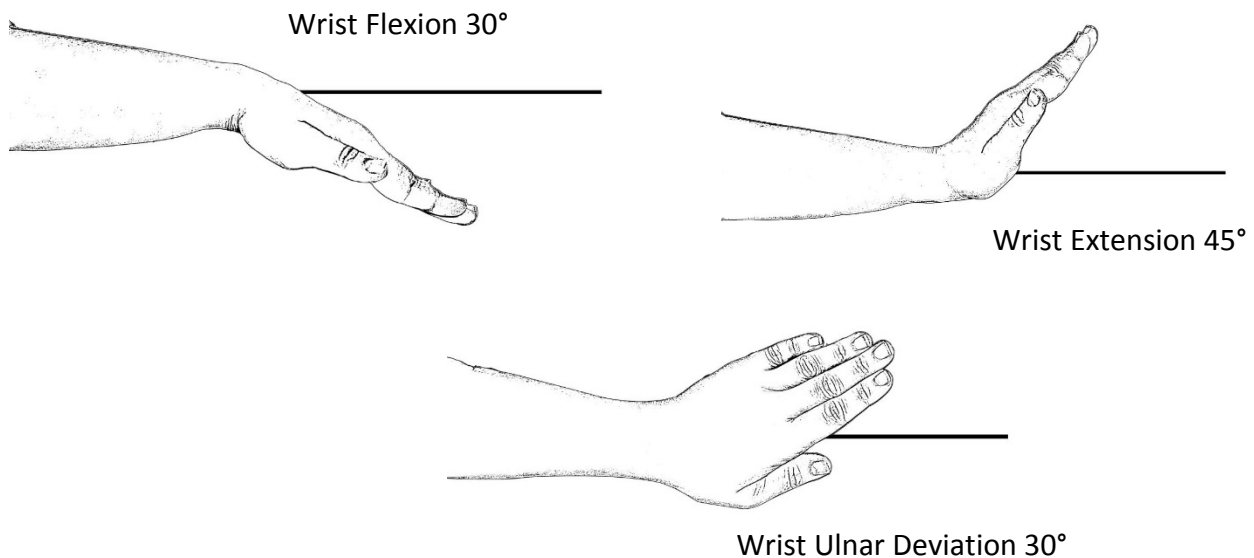
Awkward wrist postures (Figure Three):

- Wrist flexion: bending the wrist so that the palm moves closer to the wrist.
- Wrist extension: bending the wrist so that the top of the hand moves towards the forearm.
- Ulnar deviation: bending the wrist sideways, moving the little finger towards the forearm.

Risk Level Definitions

Risk Factor	Risk Levels Based on Daily Duration of Exposure		
	Low	Moderate	High
Intensive Keying	≤ 4 hours	> 4 hours	≥ 4 hours PLUS Awkward wrist postures, OR
			> 6 hours, no other risk factors

Figure Three. Awkward Wrist Postures



Hand Repetition – Repeated Impacts

- These questions evaluate the risk of hand/wrist WMSDs from intensive keying or prolonged data entry – prolonged, continuous data entry or keying activities.
- The risk of injury is increased when intensive keying is combined with awkward wrist postures.

General Measurement Guidelines

1. Consider activities where the palm or base of the hand is repeatedly used as hammer.
2. Fingers may be straight or curled in to form a fist.
3. The use of gloves do not exclude hand impacts as a risk factor, unless the gloves are specifically padded to cushion the hand from impact.
4. To determine the duration of the exposure, consider only the time of the hand impacts and not the total of the activity where the hand impacts occur.

Risk Level Definitions

Risk Factor	Risk Levels Based on Daily Duration of Exposure		
	Low	Moderate	High
Repeated Hand Impacts	Using the hand as hammer \leq 10 times/hour	Using the hand as hammer $>$ 10 times/hour, for $>$ 2 hours per day	Using hand as hammer $>$ once per minute, for \leq 2 hours per day
	Using the hand as hammer for \leq 2 hours		

Repetitive Foot Motions

- Considers the physical load of the foot from the use of foot controls.
- Foot controls can be classified as pedals or switches.
- Operating foot controls while standing can distort body posture.

General Measurement Guidelines

1. Repetitive Foot Control Use:

- Consider the posture of the foot during the use of the control, while either standing and sitting.
- Consider the posture of foot between control use. Notice if the foot hovers over control and does not relax.

2. Other Risk Factors: The risk of injury increase when frequency of use is combined with:

- Awkward foot/leg postures.
- Forceful foot action.

Risk Level Definitions

Risk Factor	Risk Levels Based on Daily Duration of Exposure		
	Low	Moderate	High
Repetitive Foot Motions	≤ 2 hours	> 2 hours	>2 hours PLUS awkward foot/leg postures
			>2 hours PLUS forceful foot exertions
			> 6 hours with no other risk factors

Checklist Definitions

Awkward foot/leg postures: Consider the following:

- Changes in body posture necessary to reach foot controls.
- Foot remains in non-neutral/non-resting position at all times.

Forceful foot exertion: Consider the following:

- The body posture changes in order to activate the foot control.
- The entire leg is necessary in order to activate the foot control.

Hand Gripping – Pinch Grip

- The questions evaluate the risk of hand/wrist WMSDs from handling objects with a pinch grip.

General Measurement Guidelines

1. Considers the risk of injury from the hand force generated by supporting the full weight of an object with the fingertips of ONE hand.
2. The evaluation is triggered when an object, either weighing 2 or more pounds or gripped with a force of ≥ 4 pounds, is held.
3. Four pounds of hand force is approximately equivalent to:
 - Pinching a clothespin open.
 - Holding a half ream of paper with a pinch grip.

Risk Level Definitions

Risk Factor	Risk Levels Based on Daily Duration of Exposure		
	Low	Moderate	High
High Hand Force – Pinch Gripping	≤ 2 hours	> 2 hours	>3 hours PLUS awkward wrist postures
			>3 hours PLUS highly Repetitive hand/wrist motions
			> 4 hours with no other risk factors

Checklist Definitions

Pinch grip: Holding an unsupported object with the fingertips of ONE HAND.

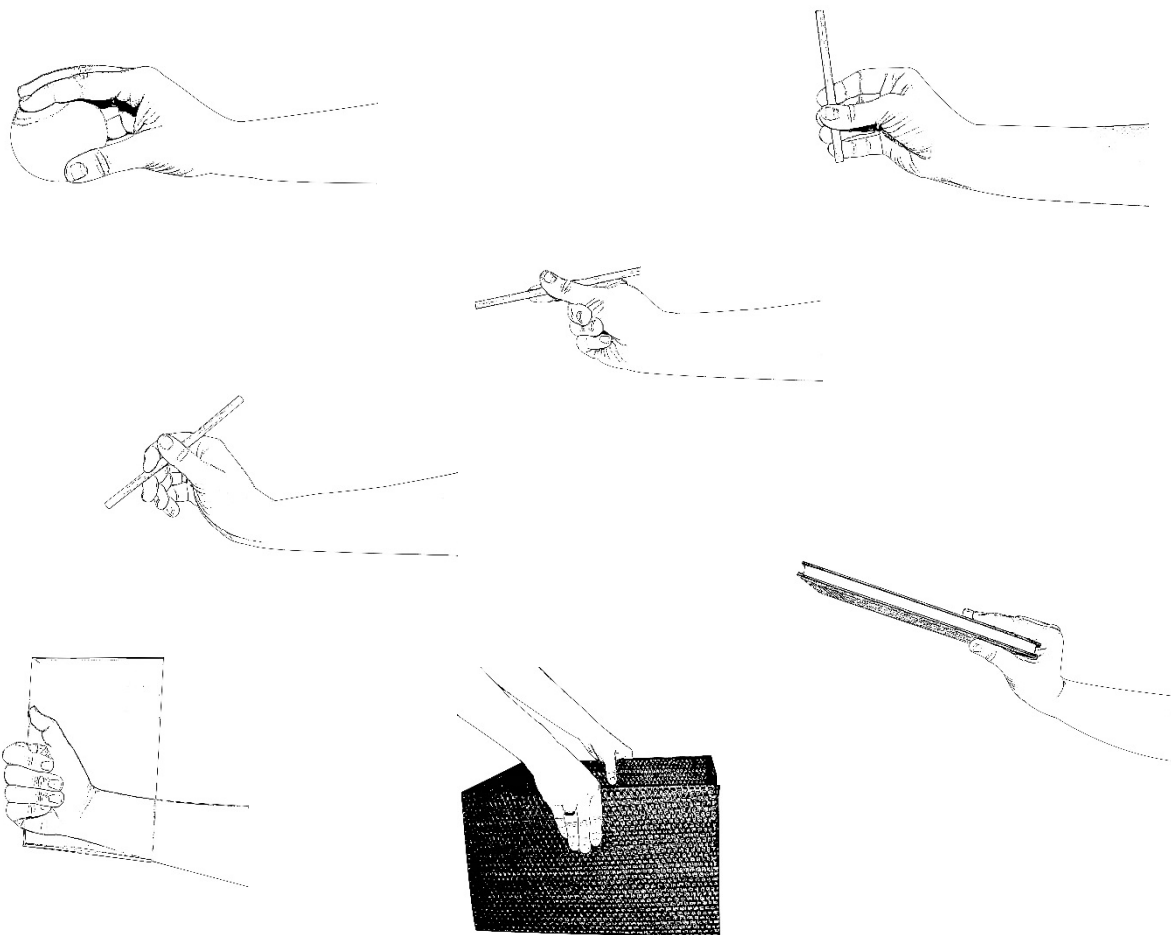
- See [Figure Four](#) for examples of pinch grips.

Highly repetitive motions: Using the same motion in the wrist with little or no variation every few seconds.

Awkward Wrist Postures ([Figure Five](#))

- Wrist flexion: Bending the wrist 30° so that the palm moves closer to the wrist.
- Wrist extension: Bending the wrist 45° so that the top of the hand moves towards the forearm.
- Ulnar deviation: Bending the wrist sideways 30° , moving the little finger towards the forearm.

Figure Four. Examples of Pinch Gripping



Not considered pinching: Hook Grips

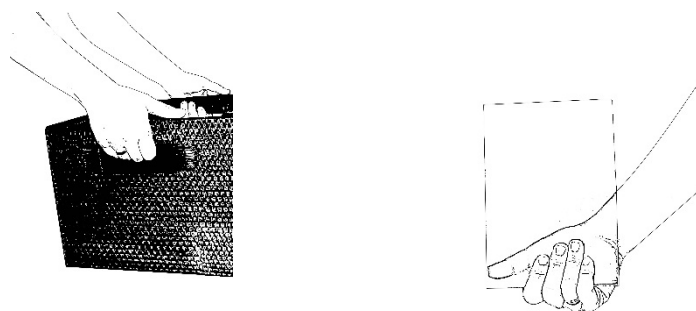
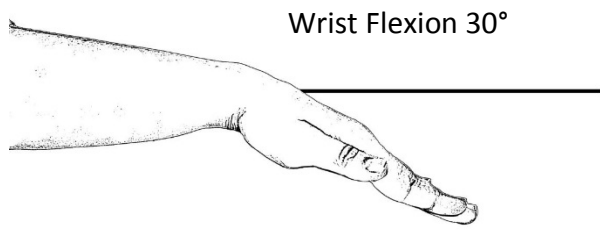
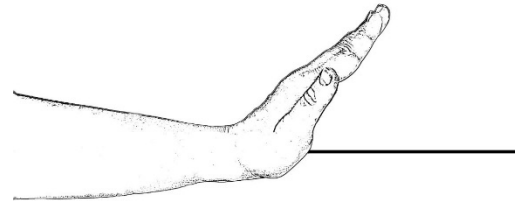


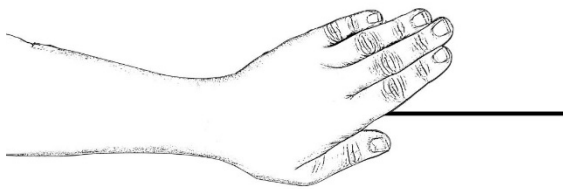
Figure Five. Awkward Wrist Postures



Wrist Flexion 30°



Wrist Extension 45°



Wrist Ulnar Deviation 30°

Hand Gripping – Power Grip

- The questions evaluate the risk of hand/wrist WMSDs from handling objects with a power grip.

General Measurement Guidelines

1. Considers the risk of injury from the hand force generated by supporting the full weight of an object with the fingers of ONE hand.
2. The evaluation is triggered when an object, either weighing 10 or more pounds or gripped with a force of ≥ 10 pounds, is held.
3. Ten pounds of hand force is comparable to clamping a light duty automotive jumper cable onto a battery.

Risk Level Definitions

Risk Factor	Risk Levels Based on Daily Duration of Exposure		
	Low	Moderate	High
High Hand Force – Power Gripping	≤ 2 hours	> 2 hours	>3 hours PLUS awkward wrist postures
			>3 hours PLUS highly repetitive hand/wrist motions
			> 4 hours with no other risk factors

Checklist Definitions

Power grip: Holding an unsupported object in the palm of ONE HAND with the fingers wrapped around.

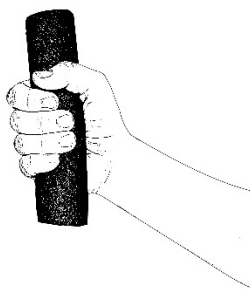
- See [Figure Six](#) for examples of Power Gripping

Highly repetitive motions: Using the same motion in the wrist with little or no variation every few seconds.

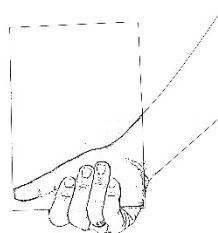
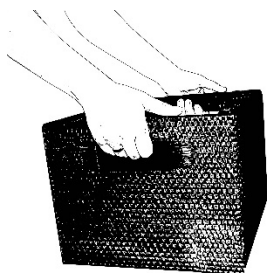
Awkward wrist postures ([Figure Five](#))

- Wrist flexion: Bending the wrist 30° so that the palm moves closer to the wrist.
- Wrist extension: Bending the wrist 45° so that the top of the hand moves towards the forearm.
- Ulnar deviation: Bending the wrist sideways 30° , moving the little finger towards the forearm.

Figure Six. Examples of Power Gripping



Not considered Power Gripping: Hook Grips



Manual Material Handling - Lifting

- These questions determine the threshold limit value (TLV) of manual lifting for specific lifting conditions that would protect nearly all workers from low back and shoulders WMSDs associated with repetitive lifting.
- The risk level analysis is based on the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) for lifting, version 2004.
- Weight limits are based on the location of the hands during the lift, the cumulative time spent lifting and the frequency of lifting.

General Measurement Guidelines

1. In addition to the start of the lift, the destination of the lift should be considered as well since this may pose as great a risk.
 - If the load is placed at the destination in a controlled manner, consider assessing the risk using the vertical and horizontal zone at the end of the lift.
2. Consider two-handed, mono-lifting tasks (loads are similar, starting and destination points are repeated, and lifting task is the only one performed during the day).

Risk Level Definitions:

Risk Factor	Risk Levels Based on Ratio of Object Weight to TLV* Weight		
	Low	Moderate	High
Manual Lifting	Ratio \leq 1	Ratio = 1-2	Ratio $>$ 2

*TLV = Threshold Limit Value

Checklist Definitions

Proximity to body: The horizontal distance of the hands from the body during a lift.

- The distance from the middle of the load to the midpoint of the inner ankle bone.

Hand Height: The vertical distance of the hands during a lift.

- Knuckle height: Position of the knuckles when standing erect and arms hanging at the sides.
- Mid-shin height: The half-way point between the middle of the knee and the middle of the ankle bone.

***SPECIAL NOTE:**

When lifting is performed in combination with the following factors that also contribute to risk, consideration should be given to reducing the weight limits further than recommended:

- High frequency lifting greater than 1 lift per 10 seconds.
- Extended work shifts more where lifting is performed more than 8 hours per day.
- Lifting more than 30 degrees away from the sagittal plane.
- Rapid lifting motions with twisting of the torso.
- Lifting while seated or kneeling (constrained lower body posture).
- One-handed lifting.
- Lifting in constrained postures, such as while seating, kneeling.
- Lifting in high heat and humidity.
- Lifting unstable objects.
- Poor hand coupling.
- Unstable footing.
- Lifting during or immediately following exposure to whole-body vibration.

Manual Material Handling - Carrying

- The questions collect data used to help estimate the portion of the population that would find the carrying demands acceptable as a regular part of daily work.
- Risk levels coincide with the percentage of the population who would find the carrying demand acceptable.
 - The greater the percent acceptable, the lower the presumed risk.
- Risk levels for carrying were determined using the tables created by Thomas E. Bernard of the University of South Florida, using data obtained from tables created by SH Snook and VM Ciriello (1991)⁶, commonly referred to as the Snook and Ciriello Tables.
[\[http://personal.health.usf.edu/tbernard/ergotools/\]](http://personal.health.usf.edu/tbernard/ergotools/)
- Carrying analysis is an adaption of the guidance developed by the Liberty Mutual Insurance Company.

General Measurement Guidelines

1. To be the most protective, the most extreme carrying activity should be used in the risk determination.
2. If various loads are carried, different approaches may be used to determine the exposure.
 - Use the characteristics of the most common carry (most common weight, most common distance carried).
 - Use the most extreme case (heaviest weight, longest distance carried).
3. The evaluation should not be used to determine the risk from catching or throwing items.

Risk Level Definitions

Risk levels are based on the proportion of the population that should be able to do this activity.

Risk Factor	Risk Levels		
	Low	Moderate	High
Carrying	≥ 75% of women	50% - 75% of women	≤ 50% of women

Checklist Definitions

Weight: Weight of the objects being carried.

Distance: The distance the item is carried with its weight is fully supported by the worker(s).

Frequency: The number of carries performed in a specified period of time.

Manual Material Handling – Pushing/Pulling

- The questions collect data used to help estimate the portion of the population that would find the pushing/pulling demands acceptable as a regular part of daily work.
- The analyses for this evaluation estimates the portion of the population who would find the push or pull demands acceptable.
 - The greater the percent acceptable, the lower the presumed risk.
- Risk levels for pushing and pulling were determined using the tables created by Thomas E. Bernard of the University of South Florida [<http://personal.health.usf.edu/tbernard/ergotools/>].
- The Bernard Push/Pull analyses is an adaption of the guidance developed by the Liberty Mutual Insurance Company. Analysis uses data obtained from tables created by SH Snook and VM Ciriello (1991)⁶, which are commonly referred to as the Snook and Ciriello Tables.
- The level of risk from pushing or pulling is determined using the initial force only – the force required to overcome inertia and start the object in motion.
 - Application of sustained push/pull forces (the force required to keep the object in motion) is not considered.
- From the Bernard tables, only the recommendations from the Snook and Ciriello initial force values were considered in the determination of risk level.

General Measurement Guidelines:

1. Measurement requires a spring scale, load cell or other force-measuring device to determine push or pull forces.
2. There are different methods to determine push/pull forces. To be the most protective, the maximum force value should be used in the risk determination.
3. Taking more than one measurement is recommended.
4. When both push and pull forces are indicated, the checklist chooses the force that produces the highest risk.
5. Consideration of only initial push/pull forces was chosen because:

- The initial force is most often high than the sustained force.
 - The measurement of the initial force is more easily measured using simple tools, while measurement of sustained forces requires sophisticated instrumentation.
6. If push/pull forces occur in different areas of the work space, approaches to determine the push/pull forces include:
- Measure push/pull forces in the different work areas and accept the maximum.
 - Measure push/pull forces in the different areas and accept the average.
7. If there are a variety of different loads, approaches to determine the push/pull forces includes:
- Measure force for a variety of loads and accept the maximum.
 - Measure force for a variety of loads and accept the average.
 - Measure the force for the most common.
8. If multiple mechanical tools are used, approaches to determine push/pull forces include:
- Measure the force for each and accept the maximum.
 - Measure the force for each and accept the average.
 - Measure the force for the most commonly used.

Risk Level Definitions

Risk levels are based on the proportion of the population that should be able to do the activity.

Risk Factor	Risk Levels		
	Low	Moderate	High
Pushing	≥ 75% of women	50% - 75% of women	≤ 50% of women
Pulling	≥ 75% of women	50% - 75% of women	≤ 50% of women

Checklist Definitions:

Pushing: A force directed away from the body and involves forward walking; using a person's physical ability to move an object across a surface between 2 points.

Pulling: A force directed towards the body and involves either forward or backwards walking; using a person's physical ability to move an object across a surface between 2 points.

Hand/Arm Vibration

- This question quantifies the hand/arm vibration that occurs from the use of vibrating hand tools.

General Measurement Guidelines

1. Hand/Arm vibration, also known as segmental vibration, can be caused by operating hand-held power tools, hand-guided machinery or by hand-fed machines.
2. The evaluation is based on the duration of exposure.
3. The duration of exposure is estimated by the worker.
4. The level of vibration not considered in evaluation.
5. The evaluation can involve one tool or all tools used during the analysis period.
6. Damaged, improperly maintained or old equipment may have vibration levels higher than manufacturer's specifications.

Risk Level Definition

Risk Factor	Risk Levels Based on Calculated Scores		
	Low	Moderate	High
Hand/Arm Vibration	1	4	9

Whole Body Vibration

- These questions determine the level of vibration the body is exposed to.
- Based on European Vibration Directive (EU Directive 2002/44/EC).

General Measurement Guidelines

1. Whole body vibration is transmitted through the seat (such as a vehicle seat) or the feet.
2. Vibration levels can be expressed in several different ways:
 - As a single value which represents the vector sum RMS,
 - As three values which represent the magnitude of vibration in three directions (x, y and z axes).
3. From the website <http://www.vibration.db.umu.se/HkvSok.aspx?lang=en>.
 - Vibration levels can be expressed as either the vector sum or on 3 axes,
 - These three values may be described as Effective Value RMS values or peak values,
 - If there are three values, choose the highest.

Risk Level Definition

Risk levels are based on duration of exposure and total 8-hr Equivalent Vibration (WBV_{8-hr}) Level.

Risk Factor	Risk Levels		
	Low	Moderate	High
Whole Body Vibration	Duration ≤ 2.0 hours	Duration >2.0 hours, WBV _{8-hr} ≤ 1.15 m/s ²	Duration >2.0 hours, WBV _{8-hr} >1.15 m/s ²

Checklist Definitions

Moderate Risk Level: determined by the duration frequency distributions when vibration > 0.5 m/s² (EU Vibration Directive Action Limit).

Calculation of Whole Body Vibration level (WBV_{8-hr}), based on 8-hr equivalent:

- For Single vehicle:

$$WBV_{8-hr} = \sqrt{\text{exposure duration}/8} * \text{identified vibration value (m/s}^2\text{)}$$

- For Multiple vehicles:

- 1) Determine partial vibration level for each vehicle:

$$\text{Partial vibration (pvib}_i) = \sqrt{\text{exposure duration}/8} * \text{identified vibration value (m/s}^2)$$

- 2) Determine total vibration level for all vehicles:

$$\text{WBV}_{8\text{-hr}} = \sqrt{(\text{pvib}_1)^2 + (\text{pvib}_2)^2 + (\text{pvib}_3)^2 + (\text{pvib}_i)^2}$$

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APPENDIX ONE: Manufacturing Physical Job Evaluation Checklist Items Sources

Washington Caution/Hazard Zone Checklist ^{4,5}

Hand Gripping – Pinch Grip
Hand Gripping – Power Grip
Hand Repetition – Intensive Keying
Hand Repetition – Repeated Impacts
Lower Extremities – Kneeling, Squatting
Neck Postures

Quick Exposure Checklist (QEC) ^{1,2}

Back Postures
Hand/Arm Vibration
Maximum Weight Handled
Neck Postures
Pace of Work
Shoulder Postures
Work Duration
Work-Related Stress

Thomas Bernard Manual Material Handling Tables ⁷

Manual Material Handling – Carry
Manual Material Handling – Push/Pull

Hand Exertions ³

The Strain Index

European Union Vibration Directive ⁸

Whole Body Vibration

American Conference of Governmental Industrial Hygienists (ACGIH) Lifting TLV ⁹

Manual Material Handling - Lifting

Ergonomists Consensus

Repetitive Foot Motions

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