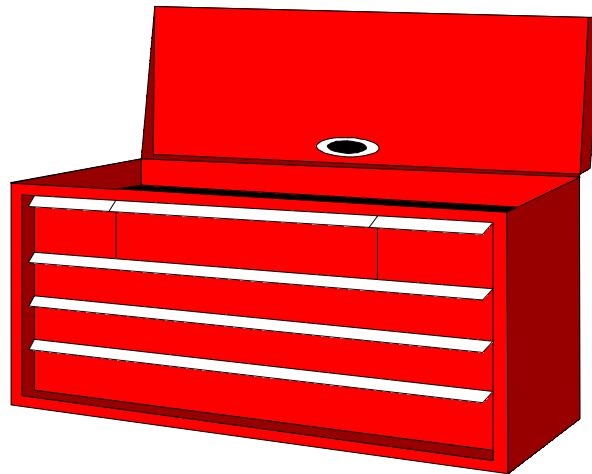


INDUSTRIAL MUSCULOSKELETAL INJURY REDUCTION PROGRAM

Common Industry Jobs (CIJs) Bulldozer Operator Tool Kit



IMIRP program coordinated by:



Council of
Forest
Industries



Industrial
Wood & Allied
Workers of
Canada



Advanced
Ergonomics
Inc.

In cooperation with the Workers' Compensation Board of British Columbia

BULLDOZER OPERATOR TOOL KIT

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Bulldozer Operator Tool Kit

Overview

Bulldozer Operator

Job Summary

A Bulldozer Operator is responsible for operating a bulldozer to complete different tasks and functions. A Bulldozer Operator will use controls to operate the bulldozer to flatten debris, maintain the log yard, and pull equipment out of the mud. A Bulldozer Operator will also manually change the position of the blade, operate winch controls, and perform maintenance tasks. Refer to the Physical Demands Analysis for more detail.

Physical Demands

The physical demands of the Bulldozer Operator may include:

- a) Forceful movements of the low back
- b) Repetitive movements of the neck, neck/shoulder, and wrist/hand
- c) Awkward postures of the neck, neck/shoulder, wrist/hand, and low back
- d) Static postures of the neck/shoulder and low back
- e) Whole-body vibration transmitted to the low back
- f) Hand-transmitted vibration of the wrist/hand
- g) Sitting in the bulldozer cab
- h) Climbing on and off the bulldozer
- i) Pushing/pulling the blade to position

Mental Demands

A Bulldozer Operator uses controls to manoeuvre a bulldozer to perform a specific task. A Bulldozer Operator must be aware of his surroundings and his machine at all times. Working in close proximity with other mobile equipment increases the mental demands of a Bulldozer Operator.

**Major
Variations**

With different mills, the following major variations may be found:

- 1) A Bulldozer Operator may use a bulldozer to:
 - a) Flatten debris
 - b) Maintain the log yard
 - c) Pull equipment out of the mud

- 2) A Bulldozer Operator may:
 - a) Manually change the position of the blade with force
 - b) Manually change the position of the blade with minimal force

**Minor
Variations**

With different mills, the following minor variations may be found:

- 1) Bulldozer maintenance will be the responsibility of:
 - a) The operator
 - b) The mill mechanic(s)

Physical Demands Analysis Bulldozer Operator

PDA General Instructions: Bulldozer Operator

The purpose of this PDA is to familiarise healthcare professionals with the physical demands of a Bulldozer Operator. This PDA can be used to gather information about an individual's job and to assist in developing a rehabilitation and return-to-work plan. It is not intended for use in claims adjudication.

Where applicable, common industry job data (e.g., hand tools, tasks) have been included in the tables of this document. The information reported was collected from a sample of Bulldozer operators in the BC Sawmill Industry. However, the PDA requires completion by the healthcare professional, with input from the injured worker to highlight tasks that aggravate the injury or prevent the worker from returning to their job. The worker's supervisor may be contacted for further information or verification of tasks.

A PDA should be filled out for each individual worker following an injury. Subsequent changes in the work process may reduce the accuracy of any pre-existing physical demands assessments. The IMIRP Society accepts no responsibility for the use or misuse of this Physical Demands Analysis, or for the accuracy of the PDA as it applies to any specific workplace.

Disclaimer

*The IMIRP Society accepts no responsibility for the use or misuse of the PDA,
or the accuracy of the PDA as it applies to any specific workplace.*

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Physical Demands Analysis Bulldozer Operator

Task List

For each of the tasks listed below, please indicate whether it occurs at your mill.

Operate bulldozer

A Bulldozer Operator will use controls to manoeuvre the bulldozer to flatten debris, maintain the log yard, and pull equipment out of the mud.

Does this task occur at your mill?

Yes No



Change blade position

A Bulldozer Operator may get out of the cab to manually change the position of the blade.

Does this task occur at your mill?

Yes No



Operate winch controls

A Bulldozer Operator may use winch controls when pulling other equipment or objects into position.

Does this task occur at your mill?

Yes No



Maintenance tasks

A Bulldozer Operator may be responsible for the general maintenance of his/her machine. This maintenance may include checking fluid levels, refuelling, and cleaning the machine.

Does this task occur at your mill?

Yes No



Job Profile

Date: _____

Company Name: _____

Division: _____

Employee Name: _____

Supervisor: _____

Phone: _____

Fax: _____

Is a Return-to-Work (RTW) strategy in place? Yes No

If yes, check all that apply: Modified Job Modified Worksite Graduated RTW

Describe:

Length of shift _____ hours

Formal breaks

- Two 10 minute breaks
- One 30 minute lunch break
- Other: _____

Informal breaks

- Yes, length of break varies
- Yes, _____ minutes/shift

Work pace control

- Self-paced
- Time pressure (e.g., completing a task during the 30 minute lunch break)
- Other: _____

Job rotation

Describe:

Yes No

Work Organisation

Task Description

The table below contains a list of tasks performed by a Bulldozer operator. Use the left column to check off tasks that are present. Estimate the *Percent of Shift* each task is performed and place a check mark in the appropriate column. The *Comments* section may be used to include information related to duration, frequency, and cycle times. Further tasks can also be included under *Other*.

Task	Percent of Shift				Comments
	Rarely 0 to 5%	Occasionally 6 to 33%	Frequently 34 to 66%	Constantly 67 to 100%	
<i>Operate bulldozer</i>					<ul style="list-style-type: none"> <i>Levers and foot pedals used constantly; may vary depending on task being performed.</i>
<i>Change blade position</i>					<ul style="list-style-type: none"> <i>Frequency of this task will vary depending on the work being performed.</i>
<i>Operate winch controls</i>					<ul style="list-style-type: none"> <i>Frequency of this task will vary depending on the work being performed.</i>
<i>Maintenance tasks</i>					<ul style="list-style-type: none"> <i>Generally performed before using bulldozer</i>
<i>Other:</i>					
<i>Other:</i>					

Workstation Characteristics

Dimensions & Layout

Sketch workstation(s) and indicate relevant measurements, such as working heights and reaches.

Flooring, Displays & Seating

The table below lists several components of a workstation. For *Flooring* and *Displays* there are several options provided. Please indicate all of the options that apply to the workstation. For the *Seating* section, describe and identify the features of the seat, if applicable. The *Comments* section may be used to include additional information, especially any workstation characteristics of concern.

Workstation Characteristics	Comments
<p>Flooring (<i>Check all that apply</i>)</p> <p><input type="checkbox"/> Cement</p> <p><input type="checkbox"/> Wood</p> <p><input type="checkbox"/> Rubber matting</p> <p><input type="checkbox"/> Metal</p> <p><input type="checkbox"/> Other _____</p>	
<p>Displays (<i>Check all that apply</i>)</p> <p><input type="checkbox"/> Lights on console</p> <p><input type="checkbox"/> Mirrors</p> <p><input type="checkbox"/> Video monitors</p> <p><input type="checkbox"/> Computer monitors</p> <p><input type="checkbox"/> Scrolling display</p> <p><input type="checkbox"/> Signal lights</p> <p><input type="checkbox"/> Other: _____</p>	
<p>Seating (<i>Check all that apply</i>)</p> <p><input type="checkbox"/> Armrests</p> <p><input type="checkbox"/> Backrest</p> <p><input type="checkbox"/> Swivel seat</p> <p><input type="checkbox"/> Slide track</p> <p><input type="checkbox"/> Lumbar support</p> <p><input type="checkbox"/> Foot rest</p> <p><input type="checkbox"/> Casters # _____</p> <p><i>Indicate if adjustable:</i></p> <p><input type="checkbox"/> Height</p> <p><input type="checkbox"/> Armrests</p> <p><input type="checkbox"/> Backrest</p> <p><input type="checkbox"/> Forward tilt</p>	<p>Height of seat: _____ cm</p> <p>Depth of seat: _____ cm</p> <p>Width of seat: _____ cm</p> <p>Covering type: _____</p>

Equipment & Machinery Controls

The table below contains a list of the types of controls used by a Bulldozer operator. Use the left column to check off controls that are present at the work site. Highlight controls that may aggravate the injury, or which the worker finds difficult to use. The *Comments* section may be used to include any additional information. Further controls can be included under *Other*.

Type of Control	Function	Comments	
	<i>Levers</i>	<ul style="list-style-type: none"> • <i>Direction of the bulldozer</i> • <i>Throttle</i> • <i>Blade movement</i> 	<ul style="list-style-type: none"> • <i>Used constantly</i>
	<i>Foot pedals</i>	<ul style="list-style-type: none"> • <i>Clutch</i> • <i>Throttle</i> • <i>Brakes</i> 	<ul style="list-style-type: none"> • <i>Used constantly</i>
	<i>Other:</i>		
	<i>Other:</i>		

Physical Demands



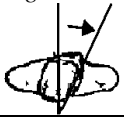

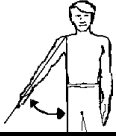

Whole Body Physical Demands



Identify each of the physical demands required by a Bulldozer operator and list the corresponding tasks in the second column. Check off (✓) the estimated *Percent of Shift*, and use the *Comments* section to include information related to duration, frequency, and cycle times.

Physical Demands	Tasks or Activity	Percent of Task				Comments
		Rarely 0 to 5%	Occasionally 6 to 33%	Frequently 34 to 66%	Constantly 67 to 100%	
<i>Example: Sitting</i>	• Operate bulldozer				✓	• Bulldozer Operator may sit for duration of 2 hours at one time
<i>Walking</i>						
<i>Sitting</i>						
<i>Standing</i>						
<i>Climbing</i>						
<i>Balancing</i>						
<i>Kneeling/ Crouching</i>						
<i>Other:</i>						





Body Postures





The table below outlines the body postures that may be adopted throughout the shift by a Bulldozer operator, related to tasks. Check off (✓) the estimated *Percent of Shift*, and use the *Comments* section to include information describing posture duration, frequency, cycle times, and hand used.

Body Posture	Task(s)	Percent of Shift				Comments
		Rarely 0 to 5%	Occasionally 6 to 33%	Frequently 34 to 66%	Constantly 67 to 100%	
<i>Example: Neck Twisting</i>	• <i>Operate bulldozer</i>		✓			• <i>Duration of neck twisting increases when operator is constantly backing up and working around other equipment</i>
Neck						
<i>Flexion</i> 						
<i>Extension</i> 						
<i>Twisting</i> 						
Shoulder						
<i>Flexion</i> 						
<i>Abduction/adduction</i> 						
<i>Extension</i> 						

Body Posture	Task(s)	Percent of Shift				Comments
		Rarely 0 to 5%	Occasionally 6 to 33%	Frequently 34 to 66%	Constantly 67 to 100%	
Forearm						
<i>Rotation</i> 						
Wrist						
<i>Wrist Movements</i> 						
Hand/Fingers						
<i>*Handling</i>						
<i>*Fingering</i>						
<i>*Gripping</i>						

Legend for Hand/Fingers

<i>Handling</i>	<i>grasping, turning, holding, etc.</i>			
<i>Fingering</i>	<i>picking, pinching, etc.</i>			
<i>Gripping</i>	<i>Power</i> 	<i>Pinch</i> 	<i>Hook</i> 	<i>Precision</i> 

Body Posture	Task(s)	Percent of Shift				Comments
		Rarely 0 to 5%	Occasionally 6 to 33%	Frequently 34 to 66%	Constantly 67 to 100%	
Back						
<i>Flexion</i> 						
<i>Lateral Flexion</i> 						
<i>Twisting</i> 						
<i>Extension</i> 						

Manual Material Handling

The table below contains a list of general manual material handling activities performed by a Bulldozer operator. Indicate tasks that require one or more of these activities, and fill in the weight of the objects, or the force required, for each action. Check off (✓) the estimated *Percent of Shift*, and use the *Comments* section to include information related to duration, frequency, cycle times, and characteristics of objects handled.

Activity	Task Description	Weight (kg)	Percent of Shift				Comments
			Rarely 0 to 5%	Occasionally 6 to 33%	Frequently 34 to 66%	Constantly 67 to 100%	
<i>Pushing</i>							
<i>Pulling</i>							
<i>Lifting</i>							
<i>Lowering</i>							
<i>Carrying</i>							

Hand Tools

Indicate the hand tools used by a Bulldozer operator by placing a check mark (✓) in the far left column. Determine the weight of the hand tool and enter it in the appropriate column. Check off (✓) the estimated *Percent of Shift*, and use the *Comments* section to include information related to duration, frequency, cycle times, and characteristics of objects handled.

Type of Tool	Task(s)	Weight (kg)	Percent of Task				Comments
			Rarely 0 to 5%	Occasionally 6 to 33%	Frequently 34 to 66%	Constantly 67 to 100%	
<i>Other:</i>							

Environmental Conditions

Work Environment

The table below contains a list of environmental conditions that may be of concern. If any of these factors aggravate the injury, describe in the *Comments* section.

Factor	Comments
Vibration (<i>Indicate source</i>) <input type="checkbox"/> Seat <input type="checkbox"/> Floor <input type="checkbox"/> Tool <input type="checkbox"/> Other: _____	
Noise level	<ul style="list-style-type: none"> • <i>The average value found in the industry for a open cab design was 93 dB</i>
Lighting level	
Other:	

Location of Workstation

The table below contains a list of potential work environments. Indicate with a check mark (✓) in the left column which of the work environments apply to the specific workstation. For example, the workstation may be inside a building with both a local fan and heater, exposed to the outside by a doorway that is always open. In this situation, 'Inside exposed', 'Heater present', and 'Fan present' would all be checked.

Work Environment	
	Outside uncovered
	Outside covered
	Inside enclosed
	Inside exposed
	Heater present
	Fan present

Temperature

The table below contains a list of the geographical regions of British Columbia. Indicate the appropriate region with a check mark (✓) in the left column. Refer to the regional map in Appendix A of the PDA.

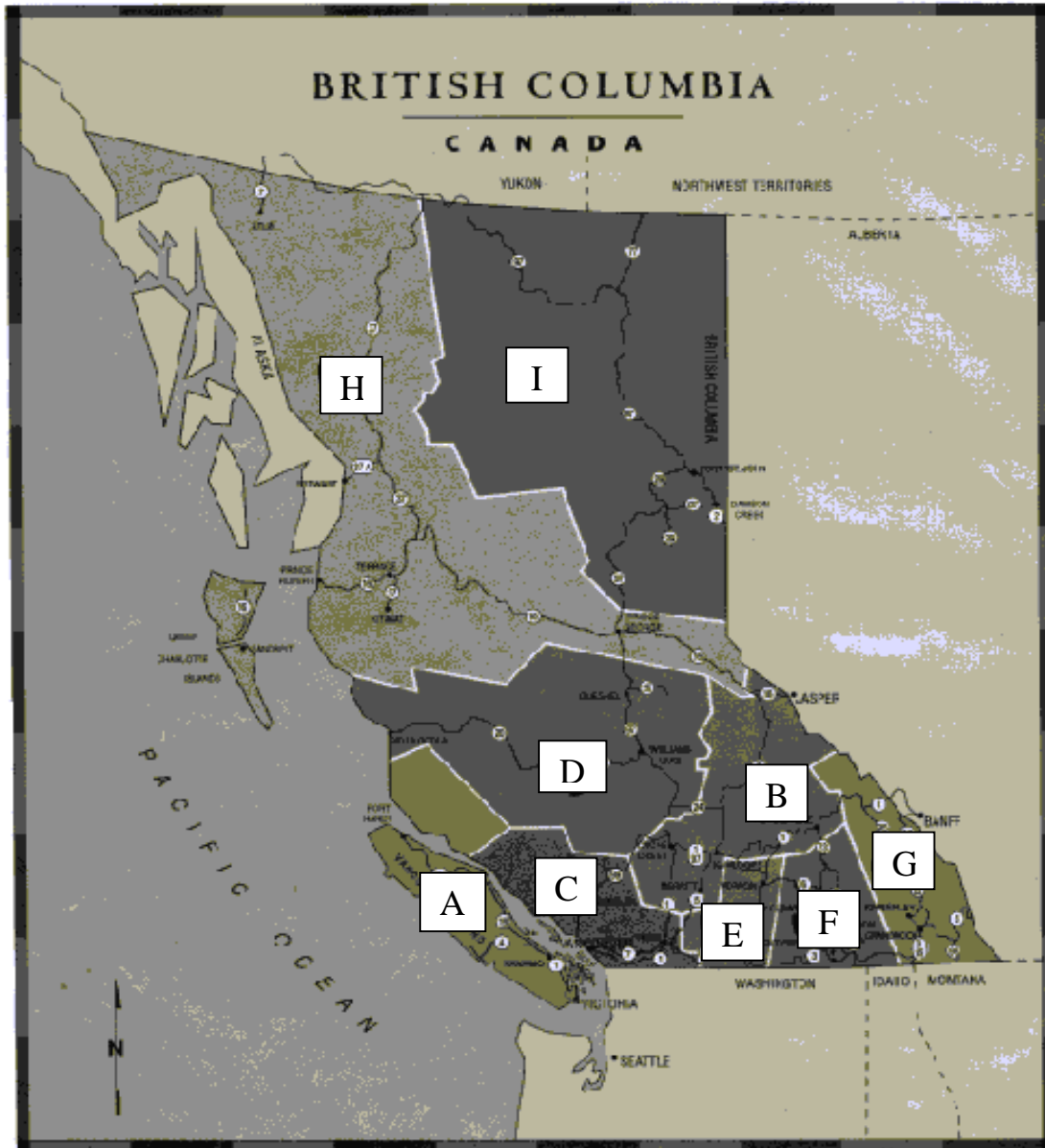
Region	Avg. Max July/Aug	Avg. Min Dec/Jan	Extreme Max.	Extreme Min.
<input type="checkbox"/> Vancouver Island	22.5 °C	-0.6 °C	36.1 °C	-18.8 °C
<input type="checkbox"/> Southwestern BC	22.9 °C	0.4 °C	35.6 °C	-18.3 °C
<input type="checkbox"/> Cariboo Chilcotin Coast	22.2 °C	-11.6 °C	36.4 °C	-42.5 °C
<input type="checkbox"/> High Country	26.3 °C	-9.9 °C	39.6 °C	-39.7 °C
<input type="checkbox"/> Okanagan Similkameen	26.5 °C	-8.4 °C	36.0 °C	-36.3 °C
<input type="checkbox"/> Kootenay Country	26.2 °C	-6.7 °C	38.5 °C	-32.0 °C
<input type="checkbox"/> British Columbia Rockies	24.7 °C	-12.3 °C	37.5 °C	-42.2 °C
<input type="checkbox"/> North by Northwest	19.5 °C	-11.7 °C	32.9 °C	-38.1 °C
<input type="checkbox"/> Peace River Alaska Highway	20.0 °C	-20.2 °C	34.6 °C	-47.7 °C

Personal Protective Equipment

The table below contains a list of the personal protective equipment (PPE). For the Bulldozer job at your mill, indicate with a check mark (✓) which of the PPE items are required.

<input type="checkbox"/>	Gloves Type:	<input type="checkbox"/>	Hard Hat	<input type="checkbox"/>	Leather Apron
<input type="checkbox"/>	Glove Liners	<input type="checkbox"/>	Steel-toed Boots	<input type="checkbox"/>	Dust Mask
<input type="checkbox"/>	Eye Protection	<input type="checkbox"/>	Hearing Protection	<input type="checkbox"/>	Seat Belt
<input type="checkbox"/>	Face Shield/Helmet	<input type="checkbox"/>	Life Jacket	<input type="checkbox"/>	Harness
<input type="checkbox"/>	Knee Pads	<input type="checkbox"/>	Other:	<input type="checkbox"/>	Other:

Appendix A – Regional Map



- | | |
|------------------------------------|---------------------------------------|
| A - Vancouver Island | F - Kootenay Country |
| B - High Country | G - British Columbia Rockies |
| C - Southwestern BC | H - North by Northwest |
| D - Cariboo Chilcotin Coast | I - Peace River Alaska Highway |
| E - Okanagan Similkameen | |

Risk Factor Identification Checklist

Bulldozer Operator

Purpose

The Risk Factor Identification Checklist for a Bulldozer Operator is used to **identify** potential ergonomic risk factors. Keep in mind that the purpose of this checklist is only to **identify** potential ergonomic risk factors, **not** to assess them.

The checklist can be used as part of your ergonomic intervention process, when workers express concerns about their work environment, during regular workplace inspections and observations, or when conducting an accident or injury investigation. Ideally, management and worker representatives who have completed the IMIRP Occupational Health & Safety Committee and Supervisor Ergonomic Training Session should complete this checklist. Try to view different workers in the same occupation when completing the checklist. Some specific examples are given to help answer the questions.

Instructions

General

Except for the first two questions, all remaining questions will require an answer with an implied frequency. For appropriate questions indicate with a check mark whether the answer to the question is 'No' or 'Yes'. This way you will have a record indicating that all risk factors have been considered in the identification process.

If you indicate 'No', please continue to the next question. If the question refers to a situation which does not exist (e.g., there is no seating available), please indicate 'No' in the appropriate box and continue to the next question.

If your answer is 'Yes', please check the appropriate box and then circle the frequency ('S' for 'Sometimes' or 'O' for 'Often'). If you answer 'Yes – Sometimes', then this risk factor **may be** a potential area of concern. If you answer 'Yes – Often' then there is an increased likelihood that this risk factor **is** an issue. Each mill will be responsible for defining what 'Sometimes' and 'Often' will mean to them. It is important that all people who complete the checklist are consistent in how they determine if a risk factor occurs 'Sometimes' or 'Often'. Use the 'Comments' section to indicate specific tasks, or to make other notes about the direct risk factors.

Since ergonomic risk factors frequently occur in combinations, you may find similar questions in different sections. Answering all questions will ensure that the situations that involve combinations of ergonomic risk factors are identified. It is very important to recognise all risk factors that occur in the work area.

Please note that for some of the questions it will be beneficial to ask the worker for their input. Please take the opportunity to include the operator in the risk factor identification process as much as possible. Videotaping the job of interest and reviewing the checklist in a quiet area with the worker may allow for more discussion.

Summary Tables

At the end of each body part section, summarise your findings in the table provided. If any of the direct risk factor sections contain a 'Yes', indicate 'Yes' in the appropriate section of the summary table. Answer the questions referring to injury statistics and discomfort survey findings. If there are only 'No' answers in a direct risk factor section, indicate 'No' in the summary table for that section. Use the summary information to determine how you will use the Work Manual.

Risk Factor Identification Checklist – Bulldozer Operator

Management Representative _____

Worker Representative _____

Date _____

Risk Identification completed:

- | |
|---|
| <input type="checkbox"/> Before implementation of solutions |
| <input type="checkbox"/> After implementation of solutions |

Job History	No	Yes	Comments
1 Are there records of musculoskeletal injuries or accidents to indicate a risk of musculoskeletal injury? (refer to Worksheet 1 in Implementation Guide)			
2 Are there worker comments to indicate a risk of musculoskeletal injuries? (refer to Worksheet 2 in Implementation Guide)			

Definitions

Force: Force is the amount of physical effort required by the person to do a task and/or maintain control of tools and equipment. The effort depends on the type of grip, object weight and dimensions, body posture, type of activity, surface of the object, temperature, vibration, duration of the task, and number of repetitions.

Repetition: Repetition is defined as similar or the same motions performed repeatedly. The severity of risk depends on the frequency of repetition, speed of the movement or action, the number of muscle groups involved, and the required force. Repetition is influenced by machine or line pacing, incentive programs, piecework, and deadlines.

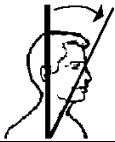
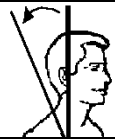
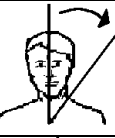

Static Postures: Static loading (sustained exertions) is physical effort (body postures) that is held, requiring muscle contraction for more than a short time.

Contact Stress: Contact stress is the contact of the body with a hard surface or edge. Contact stress can also result when using a part of the body as a hammer or striking instrument.

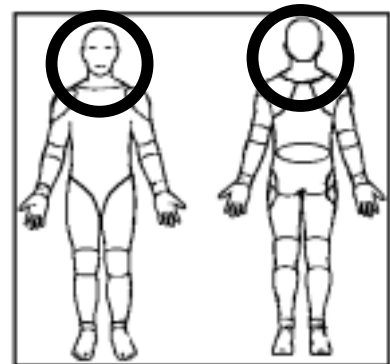
Awkward Postures: Awkward postures occur when there is a deviation from a power working posture. Some examples of awkward postures typically include reaching behind, twisting, working overhead, and forward or backward bending.

Vibration: Vibration is oscillation of a tool or surface. Vibration can be transmitted through the arm or through the whole body.

NECK

Repetition		N	Y	Comments:
Are identical or similar motions performed over and over again? (e.g., frequently looking side to side)			S O	
Ask the worker: Do you spend a large percentage of the day performing one action or task? (e.g., driving mobile equipment)			S O	
Static Posture				
Ask the worker: Do tasks require your neck or shoulders to be maintained in a fixed or static posture? (e.g., twisting to look behind while driving backwards)			S O	
Awkward Posture				
Flexion			S O	
Extension			S O	
Lateral Bending			S O	
Rotation			S O	



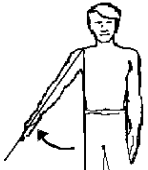
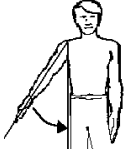
Please indicate whether the following direct risk factors were identified at the NECK .		
Direct Risk Factors	Repetition	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Static Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Awkward Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Injury Statistics investigation, were there injury reports for the Neck or Head/Eye or Upper Back? (see Worksheet 1 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Discomfort Survey investigation, were there reports of discomfort for the Neck or Head/Eye or Upper Back? (see Worksheet 2 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No



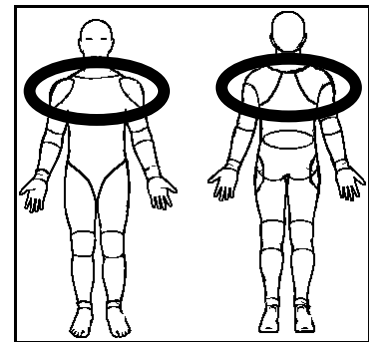
Body parts within the circled area will be classified as NECK issues.

SHOULDER

Force	N	Y	Comments:
Is forceful physical handling performed? Such as: Lifting		S O	
Lowering		S O	
Pushing		S O	
Pulling		S O	
Carrying		S O	
Repetition			
Are identical or similar motions performed over and over again? (e.g., using controls to operate machinery)		S O	
Ask the worker: Do you spend a large percentage of the day performing one action or task? (e.g., driving mobile equipment)		S O	
Static Posture			
Ask the worker: Do tasks require your shoulders to be maintained in a fixed or static posture? (e.g., operating controls located away from body)		S O	
Ask the worker: Do you hold parts, tools, or objects for long periods? (e.g., holding onto a control)		S O	




Awkward Posture		N	Y	Comments:
Flexion			S O	
Extension			S O	
Abduction			S O	
Adduction			S O	

Please indicate whether the following direct risk factors were identified at the SHOULDER .		
Direct Risk Factors	Force	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Repetition	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Static Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Awkward Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Injury Statistics investigation, were there injury reports for the Shoulder or Neck or Upper Back? (see Worksheet 1 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Discomfort Survey investigation, were there reports of discomfort for the Shoulder or Neck or Upper Back? (see Worksheet 2 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No



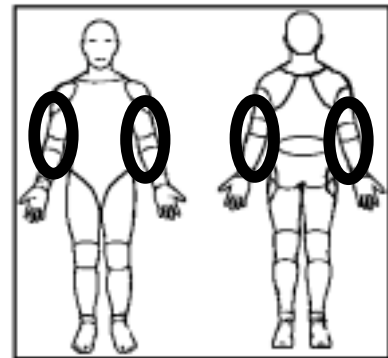
Body parts within the circled area will be classified as SHOULDER issues.

ELBOW

Force	N	Y	Comments:
Is forceful physical handling performed? Such as: Lifting			S O
Lowering			S O
Pushing			S O
Pulling			S O
Carrying			S O
Turning materials			S O
Are objects handled in a power grip? (e.g., control lever) 			S O
Are objects handled in a pinch grip? 			S O
Are objects handled in a hook grip? (e.g., oil cans) 			S O
Ask the worker: Do you wear gloves while performing your job? If the answer is No , check the No box and go to next section.		*	S O
*If the answer to the above question is Yes , ask the worker: Are the gloves too large/small? -----			S O
Does the thickness of the gloves cause problems with gripping?			S O
Repetition			
Are identical or similar motions performed over and over again? (e.g., grasping controls)			S O
Ask the worker: Do you spend a large percentage of the day performing one action or task? (e.g., grasping controls)			S O




Static Posture		N	Y	Comments:
Ask the worker: Do tasks require your hand and arm to be maintained in a fixed or static posture? (e.g., holding a control for long duration)			S O	
Ask the worker: Do you apply constant pressure on controls/objects with your hand? (e.g., control levers)			S O	
Ask the worker: Do you hold parts, tools, or objects for long periods?			S O	
Contact Stress				
Ask the worker: Do any objects, tools or parts of the workstation put pressure on any parts of your hand or arm, such as the backs or sides of fingers, palm or base of the hand, forearm, elbow? (e.g., controls that dig into the palm of the hand)			S O	
Vibration				
Ask the worker: Is vibration transmitted to your hand through a tool or piece of equipment? (e.g., through control levers)			S O	





Please indicate whether the following direct risk factors were identified at the ELBOW .		
Direct Risk Factors	Force	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Repetition	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Static Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Contact Stress	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Vibration	<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Injury Statistics investigation, were there injury reports for the Elbow or Forearm? (see Worksheet 1 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Discomfort Survey investigation, were there reports of discomfort for the Elbow or Forearm? (see Worksheet 2 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No



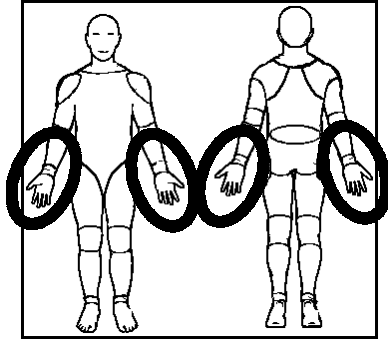
Body parts within the circled area will be classified as ELBOW issues.

WRIST/HAND

Force	N	Y	Comments:
Is forceful physical handling performed? Such as: Lifting		S O	
Lowering		S O	
Pushing		S O	
Pulling		S O	
Carrying		S O	
Turning materials		S O	
Are objects handled in a power grip? (e.g., steering wheel)		S O	
Are objects handled in a pinch grip?		S O	
Are objects handled in a hook grip? (e.g., oil cans)		S O	
Ask the worker: Do you wear gloves while performing your job? If the answer is No , check the No box and go to next section.		* S O	
*If the answer to the above question is Yes , ask the worker: Are the gloves too large/small?		S O	
Does the thickness of the gloves cause problems with gripping?		S O	
Repetition			
Are identical or similar motions performed over and over again? (e.g., operating controls)		S O	
Ask the worker: Do you spend a large percentage of the day performing one action or task? (e.g., driving mobile equipment)		S O	

Static Posture		N	Y	Comments:
Ask the worker: Do tasks require any part of your arm or hand to be maintained in a fixed or static posture? (e.g., holding controls)			S O	
Ask the worker: Do you apply constant pressure on controls/objects with your hand? (e.g., control levers)			S O	
Ask the worker: Do you hold parts, tools, or objects for long periods? (e.g., controls)			S O	
Contact Stress				
Ask the worker: Do any objects, tools or parts of the workstation put pressure on any parts of your hand or arm, such as the backs or sides of fingers, palm or base of the hand, forearm? (e.g., controls that dig into the palm of the hand)			S O	
Ask the worker: Do you use your hand like a hammer for striking? (e.g., banging on control when stuck)			S O	
Awkward Posture				
Flexion			S O	
Extension			S O	
Ulnar Deviation			S O	
Radial Deviation			S O	
Vibration				
Ask the worker: Is vibration transmitted to your hand through a tool or piece of equipment? (e.g., control levers)			S O	





Please indicate whether the following direct risk factors were identified at the WRIST/HAND .		
Direct Risk Factors	Force	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Repetition	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Static Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Contact Stress	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Awkward Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Vibration	<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Injury Statistics investigation, were there injury reports for the Wrist or Hand/Finger or Forearm? (see Worksheet 1 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Discomfort Survey investigation, were there reports of discomfort for the Wrist or Hand/Finger or Forearm? (see Worksheet 2 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No



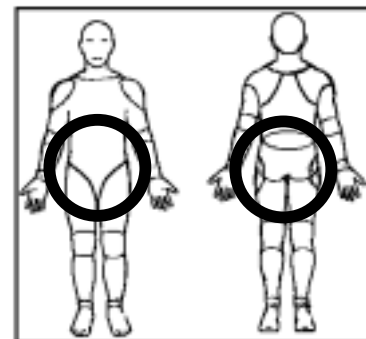
Body parts within the circled area will be classified as WRIST issues.

LOW BACK OR HIP/THIGH

Force	N	Y	Comments:
Is forceful physical handling performed? Such as: Lifting		S	
		O	
Lowering		S	
		O	
Pushing		S	
		O	
Pulling		S	
		O	
Carrying		S	
		O	
Repetition			
Are identical or similar motions performed over and over again?		S	
		O	
Ask the worker: Do you spend a large percentage of the day performing one action or task? (e.g., sitting to operate mobile equipment)		S	
		O	
Static Posture			
Ask the worker: Do tasks require your trunk and upper body to be maintained in a fixed or static posture? (e.g., sitting to operate mobile equipment)		S	
		O	
Are workers required to sit or stand in a stationary position for long periods of time during the shift? (e.g., sitting to operate mobile equipment)		S	
		O	
Contact Stress			
Ask the worker: Do any objects, tools or parts of the workstation put pressure on any parts of your hip/thigh? (e.g., seat digs into back of legs)		S	
		O	


Awkward Posture		N	Y	Comments:
Flexion			S O	
Extension			S O	
Lateral Bending			S O	
Twisting			S O	
Vibration				
Ask the worker: Is your whole body exposed to vibration for significant portions of the work shift? (e.g., sitting in vibrating machinery)			S O	

Please indicate whether the following direct risk factors were identified at the LOW BACK or HIP/THIGH .		
Direct Risk Factors	Force	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Repetition	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Static Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Contact Stress	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Awkward Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Vibration	<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Injury Statistics investigation, were there injury reports for the Low Back or Hip/Thigh? (see Worksheet 1 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Discomfort Survey investigation, were there reports of discomfort for the Low Back or Hip/Thigh? (see Worksheet 2 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No

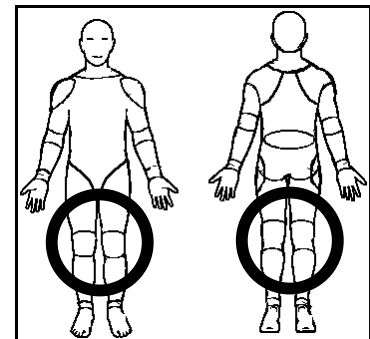


Body parts within the circled area will be classified as LOW BACK issues.

KNEE



Repetition		N	Y	Comments:
Are identical or similar motions performed over and over again? (e.g., climbing in and out of equipment)			S O	
Static Posture				
Ask the worker: Do tasks require you to maintain your knee(s) in a fixed or static posture? (e.g., sitting in mobile equipment)			S O	
Are workers required to sit or stand in a stationary position for long periods of time during the shift? (e.g., sitting in mobile equipment)			S O	
Do workers kneel (with one or both knees)? (e.g., balancing bulldozer blade)			S O	
Contact Stress				
Ask the worker: Do any objects or parts of the workstation put pressure on your knee(s)? (e.g., kneeling on hard surfaces)			S O	
Awkward Posture				
Extreme Flexion			S O	

Please indicate whether the following direct risk factors were identified at the KNEE .		
Direct Risk Factors	Repetition	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Static Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Contact Stress	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Awkward Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Injury Statistics investigation, were there injury reports for the Knee or Hip/Thigh? (see Worksheet 1 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Discomfort Survey investigation, were there reports of discomfort for the Knee or Hip/Thigh? (see Worksheet 2 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No

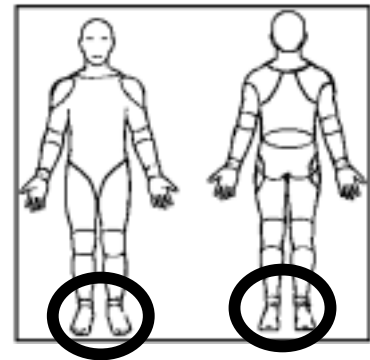


Body parts within the circled area will be classified as KNEE issues.

ANKLE/FOOT

Repetition		N	Y	Comments:
Are identical or similar motions performed over and over again? (e.g., operating foot pedals)			S O	
Static Posture				
Are workers required to stand in a stationary position for long periods of time during the shift? (e.g., standing to repair equipment)			S O	
Awkward Posture				
Flexion			S O	
Extension			S O	
Vibration				
Ask the worker: Is your whole body exposed to vibration for significant portions of the work shift?			S O	

Please indicate whether the following direct risk factors were identified at the ANKLE/FOOT .		
Direct Risk Factors	Repetition	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Static Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Awkward Posture	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Vibration	<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Injury Statistics investigation, were there injury reports for the Ankle or Foot? (see Worksheet 1 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No
In the Discomfort Survey investigation, were there reports of discomfort for the Ankle or Foot? (see Worksheet 2 in the Implementation Guide)		<input type="checkbox"/> Yes <input type="checkbox"/> No



Body parts within the circled area will be classified as ANKLE/FOOT issues.

CHARACTERISTICS OF OBJECTS BEING HANDLED

	N	Y	Comments:
Are there problems handling a load due to its size or shape? (e.g., balancing blade)		S O	
Are there problems handling a load due to its fragile, unbalanced, or non-rigid conditions? (e.g., oil, chains)		S O	
Ask the worker: Do you experience situations where mechanical aids or equipment are not readily available to assist with manipulating an object? (e.g., changing equipment attachments)		S O	
Are handles for tools and equipment inappropriate in terms of size or shape? (e.g., wrenches)		S O	
Ask the worker: Do any objects that you work with (other than tools or equipment) have handles? If the answer is No , check the No box and go to the next section.		S O	
If the answer to the above question is Yes , ask the worker: Are the handles an inappropriate size or shape for the characteristics of the object?		S O	

ENVIRONMENTAL CONDITIONS

Temperature			
Ask the worker: Are your hands or arms exposed to cold from exhaust air, cold liquids or solids?		S O	
Ask the worker: Are you exposed directly to temperature extremes that may cause you to use more force or cause you to fatigue quicker than normal? (e.g., hot or cold, either by equipment or natural environment)		S O	
Lighting			
Ask the worker: Do you assume awkward postures to overcome problems associated with glare, inadequate lighting, or poor visibility? (e.g., working in direct sunlight)		S O	

ENVIRONMENTAL CONDITIONS [CONTINUED]

Noise	N	Y	Comments:
Have there been complaints on the level of noise in the work area?		S O	
Ask the worker: Are there any distracting or annoying noises at the workstation? (e.g., alarms, horns)		S O	

WORK ORGANISATION

	N	Y	Comments:
Is the work externally-paced or controlled by a machine or the process?		S O	
Do peak workloads or sudden increases in pace occur with the tasks?		S O	
Ask the worker: Are there indications of excessive fatigue or pain, or symptoms of adverse health effects due to extended work days or overtime? (e.g., seasonal overtime)		S O	
Ask the worker: Are there indications of excessive fatigue or adverse health effects due to shiftwork? (e.g., graveyard shift)		S O	
Ask the worker: Are rest periods or task variety insufficient to prevent the build-up of fatigue or the risk of adverse health effects?		S O	
Ask the worker: Are tasks in a job rotation program similar to one another, and therefore not providing a variation in movements?		S O	

Work Manual

**Industrial
Musculoskeletal
Injury
Reduction
Program**



Bulldozer Operator

This Work Manual contains information about the body parts found to be at risk of musculoskeletal injury (MSI) for the Bulldozer Operator (Injury Education), and how to reduce the risk of MSIs using various control measures (Injury Prevention). Each Work Manual is intended to help Occupational Health and Safety Committee members establish effective solutions to reduce MSIs, and as a resource for workers to understand the MSI risks that they may encounter on the job.

The Body Manual, referenced throughout the Work Manual, is a separate document that contains information on how to prevent common MSIs through exercise. Please note exercises described in the Body Manual should only be used after consulting a healthcare practitioner.

The General Risk Factor Solutions Manual, referenced throughout the Work Manual, is a separate document that contains general, preventative information on Environmental Conditions and Work Organisation issues.

Work Manual

Bulldozer Operator

Disclaimer

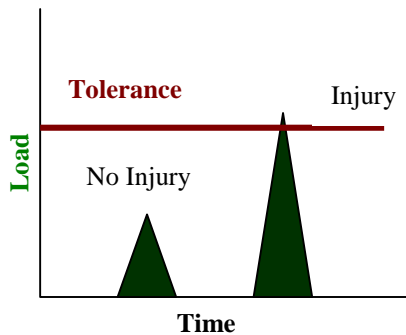
The BC sawmill IMIRP documents were developed by Advanced Ergonomics Inc. (AEI) based on analyses conducted in a number of voluntary, participating sawmills in British Columbia and should be considered applicable only to the BC sawmill industry. Modification to these documents may reduce their usefulness and/or lead to hazardous situations. Individuals or committees wishing to make Physical Demands Analyses (PDAs) site-specific, or wishing to implement options from the Work Manuals, are advised to first complete the two-day OHSC and Supervisors Ergonomics Training Session. Modifications to a PDA must be within the scope of competence of those individuals making the changes and must be reported to any rehabilitation professional using the PDA. Neither AEI nor the IMIRP Society accepts any responsibility for the use or misuse of these documents.

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Injury Education

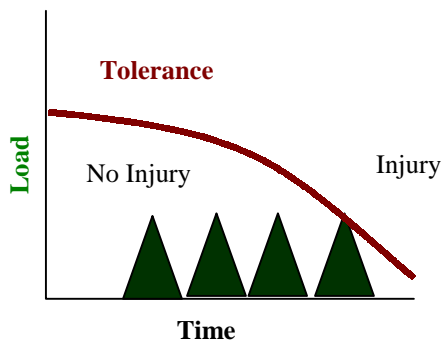
*Injuries occur when ...
Loads exceed tissue tolerances*



Excessive Force

This type of injury occurs from a single event, where the loads or forces are so great they exceed tissue tolerances and cause an immediate injury. This type of injury is more common with trips and falls.

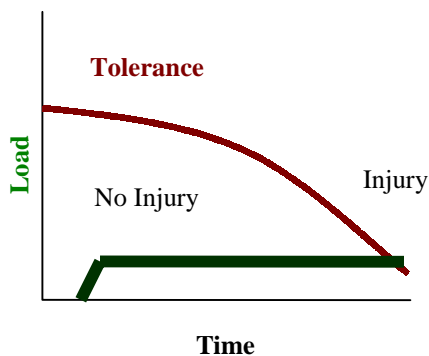
Example – a worker going over on their ankle and spraining it.



Excessive Repetition

This type of injury occurs from repeated loading weakening tissue to the point of failure. It progresses slowly to the point where a subfailure load can cause an injury. This type of injury is more common with repetitive tasks.

Example – a worker pulling lumber off a chain developing a herniated disc.



Excessive Duration

This type of injury occurs from constant loading weakening tissue to the point of failure. This type of injury is more common with tasks that require workers to adopt static or awkward postures for extended periods.

Example – a Grader developing neck tension.

Body Parts at Risk

The previous page on injury education explains how injuries can occur. The Injury Education section of this Work Manual expands on these principles, relating them to the specific body parts at risk of being injured.

After all of the appropriate information is collected during the investigation of the Bulldozer Operator job (i.e., injury statistics, discomfort surveys, results from the Identification Checklist), the next steps are to:

1. Match the body parts of concern from your investigation to those described in this section of the Work Manual.
2. Note the direct risk factors associated with each body part of concern.
3. Read the information on the page and try to understand why a body part, in combination with each of the direct risk factors, is of concern.
4. Discover which indirect risk factors are associated with a particular body part problem and the headings under which they are found in the Injury Prevention section of the Work Manual.
5. Note the consequences of the direct risk factor relative to a body part.
6. Note where the potential solutions can be found within the Injury Prevention section of the Work Manual. In addition, for many of the body parts, a reference may be provided to refer to specific sections of the Body Manual.

At the end of the Body Parts at Risk Section, there is a summary page of all the body parts of concern for the Bulldozer Operator. In addition, a reference table, with a summary of the direct and indirect risk factors by body part, is provided.

In the last section on Injury Prevention, the Work Manual discusses specific solution options for each of the body parts at risk.

Major Risk Identification

IMIRP ergonomists have assessed the Bulldozer Operator position and found that the neck, shoulder, and low back are the body parts of major concern while performing the duties. Focussing on solutions that target the areas of major concern will likely reduce the greatest risks associated with this job.

Neck: Major risks include awkward and repetitive motions of the neck when twisting to look behind while driving backwards.

The following solutions are targeted at reducing the risk of injury to the neck:

1. Good driving posture (page 69)
2. Use mirrors to view blade (page 79)
3. Hourly stretch breaks (page 80)
4. Alternate looking over shoulders (page 82)
5. Flood lighting
6. (page 85)
7. Reduce glare
8. (page 85)

Shoulder: Major risks include repetitive, awkward, and static postures of the shoulder while operating controls at the outer range of the reach envelope. The amount of force required to manipulate the controls can also contribute to the risk of discomfort or injury.

The following solutions are targeted at reducing the risk of injury to the shoulder:

1. Control distance (page 69)
2. Arm supports (page 71)
3. Adjustable seating (page 74)
4. Hourly stretch breaks (page 80)

Low Back: Major risks include awkward and forceful movements when manually adjusting the position of the blade. Awkward, static postures and exposure to vibration when sitting in the cab of the bulldozer while manipulating controls to move objects.

The following solutions are targeted at reducing the risk of injury to the low back:

1. Good driving posture (page 69)
2. Stepping down (page 72)
3. Lumbar support (page 73)
4. Vary body posture (page 74)
5. Seat maintenance (page 75)
6. Adjust seat spring (page 76)
7. Seat belts (page 76)
8. Equipment maintenance (page 77)
9. Hourly stretch breaks (page 80)
10. Task variability (page 86)

For additional stretching and strengthening exercises that would benefit a Bulldozer Operator, refer to the Neck, Shoulder, and, Low Back sections of the Body Manual.

NECK

Direct Risk Factors:
Awkward Posture
Repetition



Bulldozer Operators may repeatedly twist their neck to view their surroundings while operating a bulldozer.

BACKGROUND INFORMATION

- A number of smaller muscles around the neck produce the forces necessary to support and move the head. These muscles remain relatively relaxed when the head is balanced over the spine (neutral posture). The neutral posture occurs when the head is upright and the ears and shoulders are aligned.

DIRECT RISK FACTORS

Awkward Postures

- Neck muscles are required to turn the head to the side. The further the head is turned to the side, the greater the load on the muscles and tendons.

Repetition

- When the head is repeatedly turned to the side, the muscles of the neck are subjected to repeated stress with little time for recovery. If the repetitive stress is excessive, and recovery is not adequate, the tissues can fatigue to the point of injury.

INDIRECT RISK FACTORS

Workstation Design

Additional Workstation Design Options

- Loading on the neck muscles may be increased due to the equipment layout, which may require the operator to repeatedly twist the neck in order to view the work area.

Environmental Conditions

Lighting

- If visibility is limited due to poor lighting, workers may twist their neck and hold this posture for a longer duration.

CONSEQUENCES

- When the head is held in a twisted posture, muscles and soft tissues of the neck may fatigue. Fatigue leads to an accumulation of waste products and/or a decrease in the ability to tolerate additional stress.
- Signs and symptoms include pain, tenderness, muscle spasm in the neck area, and headaches.

SUGGESTED SOLUTIONS

- For specific solutions that may prevent injuries to the Neck, please see the column labelled “Neck” in the Summary of Solutions on pages 87 to 89.
- For exercises that can help to prevent *neck* injuries, see the *Neck section of the Body Manual*.

NECK/SHOULDER

Direct Risk Factors:

Awkward Posture

Static Posture

Repetition



Bulldozer Operators may continuously hold their arms away from their body in order to use lever controls.

BACKGROUND INFORMATION

- The neck and shoulder regions work together to produce certain movements, or to hold certain postures. The larger muscles of the neck and upper back (e.g., trapezius) elevate the shoulders, and the larger muscles of the shoulders (e.g., deltoids) raise the arms.

DIRECT RISK FACTORS

Awkward Postures

- Neck and shoulder muscles must support the weight of the arms when they are away from the body. The farther away the arms are from the body, the greater the load on the muscles and tendons.

Static Postures

- When the arms are repeatedly held away from the body, the muscles of the neck and shoulder must remain tense to support the weight. If the duration of constant tension is excessive, and recovery is not adequate, the tissues may fatigue to the point of injury.

Repetition

- When the arms are repeatedly lifted, the muscles of the neck and shoulder are subjected to repeated stress with little or no time for recovery. If the repetitive stress is excessive, and recovery is not adequate, the tissues may fatigue to the point of injury.

INDIRECT RISK FACTORS

Workstation Design

Working Reaches

- Loading on the shoulder joint is increased when the controls require excessive reaching.

CONSEQUENCES

- When the arms are held away from the body, muscles and soft tissues of the neck and shoulder may fatigue. Fatigue leads to an accumulation of waste products and/or a decrease in the ability to tolerate additional stress.
- Signs and symptoms include pain, tenderness, muscle spasm in the neck and shoulder area, and headaches.

SUGGESTED SOLUTIONS

- For specific solutions that may prevent injuries to the Neck/Shoulder, please see the column labelled “Neck/Shoulder” in the Summary of Solutions on pages 87 to 89.
- For exercises that can help to prevent *neck* and *shoulder* injuries, see the *Neck* and *Shoulder sections of the Body Manual*.

WRIST/HAND

Direct Risk Factors:

Awkward Posture

Repetition

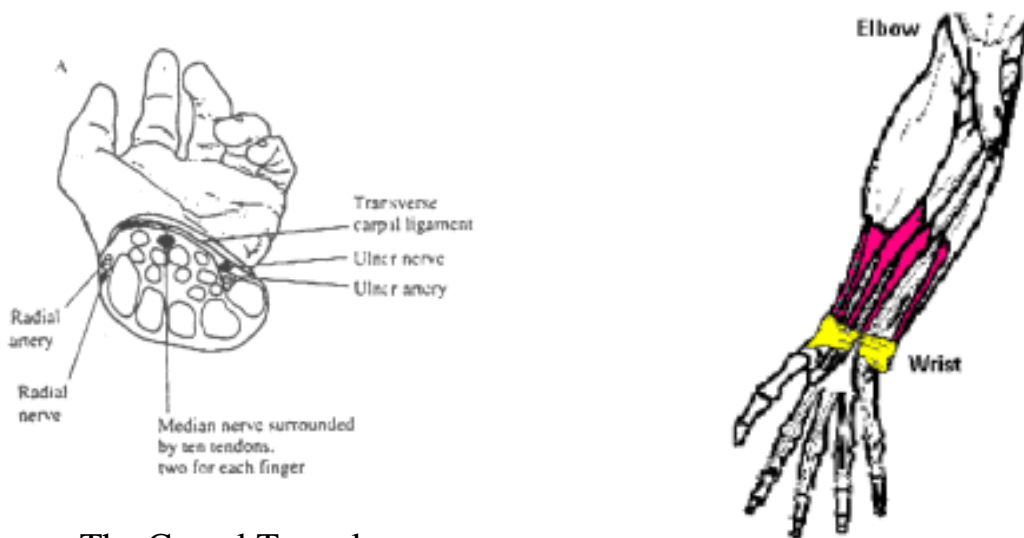
Vibration



Bulldozer Operators may continuously grip controls with their wrists bent in order to manoeuvre the bulldozer. When using controls, a Bulldozer Operator may be exposed to hand/arm vibration.

BACKGROUND INFORMATION

- Most of the muscles involved in gripping and manoeuvring the hands are found in the forearms. These muscles attach at the elbow and their tendons (surrounded by a protective sheath) run down the forearm into the hand. At the wrist, the tendons and a nerve run under a thick band (see pictures below), which forms the roof of the carpal tunnel.



The Carpal Tunnel

DIRECT RISK FACTORS

Awkward Posture

- As the wrist is bent, the tendon sheaths will rub up against the walls of the carpal tunnel. The further the wrist is bent, the more friction experienced in the tendon sheaths.

Repetition

- Repeated gripping and/or repeated bending of the wrist causes stress to the tendon sheaths. If the repetitive stress is excessive, and recovery is not adequate, the tendon sheaths may fatigue to the point of injury.

Vibration

- Exposure to vibration, through contact with vibrating objects places a unique form of mechanical stress on the tissues of the hand and wrist. Factors like vibration level and vibration frequency influence the amount of mechanical stress.
- Continual exposure to hand/arm vibration may gradually damage neurovascular tissue (nerves and blood vessels) in the hand, and may contribute to problems in the wrist.

INDIRECT RISK FACTORS

Characteristics of Objects Being Handled

Container, Tool, and Equipment Handles

- The position of controls will determine if the wrist is forced to adopt an awkward posture.
- Wrist postures may become more awkward when levers have too much travel.

CONSEQUENCES

- Repeatedly gripping objects with the wrist bent may lead to irritation and damage in the tendon sheaths. Signs and symptoms include pain, tenderness, and inflammation in the wrist area.
- Continual exposure to hand/arm vibration and contact stress may lead to neurovascular damage. Signs and symptoms include pain, whitening of the fingers, and a loss of feeling and strength in the hand.

SUGGESTED SOLUTIONS

- For specific solutions that may prevent injuries to the Wrist, please see the column labelled “Wrist” in the Summary of Solutions on pages 87 to 89.

LOW BACK

Direct Risk Factors:
Force
Awkward Posture

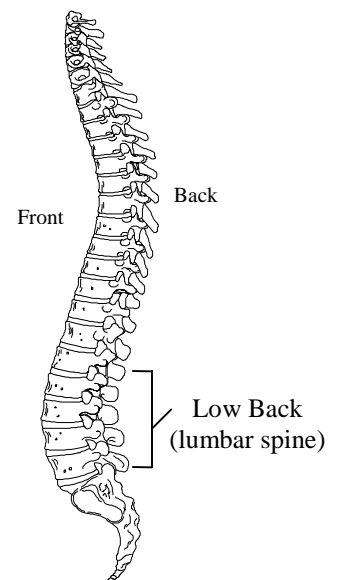


Bulldozer Operators may bend forward and apply excessive force to manually adjust the position of the blade.

Neutral Spine

BACKGROUND INFORMATION

- The spine is made up of 33 bones called vertebrae. Each of these vertebrae is specially designed to protect the spinal cord and provide support for the back. Between each of the vertebrae are discs. Discs have tough elastic walls that are filled with a watery gel-like substance. These discs are like jelly donuts; when they are pressed down on one side, the other side bulges and puts increased pressure on the wall of the disc. To maintain an even distribution of pressure across the discs, the spine has to be kept in the neutral posture.



DIRECT RISK FACTORS

Force

- Forceful pushing/pulling increases the loading on the spine. The greater the weight of the object, the greater the loading on the structures of the low back.

Awkward Posture

- Back muscles must support the weight of the upper body when leaning forward. Increased bending of the back increases the loading on the spine and increases the pressure on the walls of the discs.

INDIRECT RISK FACTORS

Workstation Design

Additional Workstation Design Options

- Loading on the shoulder joint is increased when the controls require excessive reaching.

CONSEQUENCES

- Repeatedly bending forward may lead to damage in the disc walls.
- Signs and symptoms may include muscle spasm and sharp or radiating pain in the back and/or lower extremities.

SUGGESTED SOLUTIONS

- For specific solutions that may prevent injuries to the Back, please see the column labelled “Back” in the Summary of Solutions on pages 87 to 89.
- For exercises that can help to prevent *back* injuries, see the *Back section of the Body Manual*.

LOW BACK

Direct Risk Factors:
Awkward Posture
Static Posture
Vibration

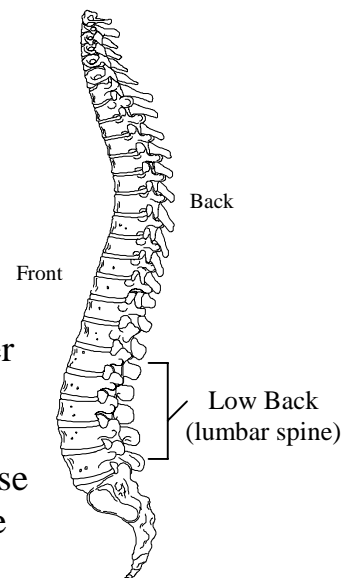


Bulldozer Operators sit continuously in vibrating machinery. Driving over uneven terrain increases the effect of vibration on the spine.

Neutral Spine

BACKGROUND INFORMATION

- The spine is made up of 33 bones called vertebrae. Each of these vertebrae is specially designed to protect the spinal cord and provide support for the back. Between each of the vertebrae are discs. Discs have tough elastic walls that are filled with a watery gel-like substance. These discs are like jelly donuts; when they are pressed down on one side, the other side bulges and puts increased pressure on the wall of the disc. To maintain an even distribution of pressure across the discs, the spine has to be kept in the neutral posture. Sitting will cause the pelvis to rotate out of a neutral posture, as the lumbar spine will flatten.



DIRECT RISK FACTORS

Awkward & Static Posture

- Sitting increases the loading on the walls of the discs. If the duration of sitting is excessive, and recovery is not adequate (e.g., spine not returned to neutral posture), tissues may deform to the point of injury.

Vibration

- Whole body vibration is usually transmitted through the seat into the low back. Exposure to whole body vibration introduces a unique mechanical stress to the structures of the spine that can significantly increase the loading on the low back. Prolonged sitting on a vibrating surface may contribute to the gradual weakening of the lumbar discs.

INDIRECT RISK FACTORS

Workstation Design

Seating

- Loading on the back can be increased when seating is poor, or is not properly adjusted and maintained.

Additional Workstation Design Options

- Vibration and loading on the back is increased when the driving surface is uneven. Yards with poor drainage tend to develop more ruts, leading to increased loading on the back.

Work Organisation

Task Variability

- Working for extended periods at seated bulldozer tasks exposes a Bulldozer Operator to increased spine loading.

CONSEQUENCES

- Continually sitting on a vibrating surface may lead to deformation in the disc walls and accelerated degeneration of the tissues.
- Signs and symptoms include muscle spasm and sharp or radiating pain in the back and/or lower extremities.

SUGGESTED SOLUTIONS

- For specific solutions that may prevent injuries to the Back, please see the column labelled “Back” in the Summary of Solutions on pages 87 to 89.
- For exercises that can help to prevent *back* injuries, see the ***Back section of the Body Manual***.

ANKLE/FOOT

Direct Risk Factors:

Awkward Posture
Static Posture
Repetition
Force



Bulldozer Operators frequently activate foot pedals in order to operate the bulldozer.

BACKGROUND INFORMATION

- The muscle responsible for pulling the foot upwards is found in the front of the shin. Its tendon runs beneath thick bands at the ankle before attaching to the foot bones.
- There are a number of small muscles in the base of the foot, as well as a tough band that attaches to the heel bone and runs down towards the toes. This band is called the plantar fascia, and it contributes to the arch in our feet.

DIRECT RISK FACTORS

Awkward Posture

- Lifting the foot to activate a foot pedal puts the ankle into an awkward posture, which increases the loading in the muscle on the front of the shin. The further away from the neutral posture the ankle is, the greater the loading to this muscle. If the shoes worn are rigid or heavy, the loading is also increased.

Static Posture

- Continual pressure on foot pedals can cause tissue in the foot to deform and breakdown over time. If the tissue deformation is excessive and recovery not adequate, an injury may occur.

Repetition

- Repetitive use of foot pedals may gradually cause small tears in the muscle on the front of the shin. If the repetitive stress is excessive, and recovery is not adequate, the small tears in the muscle on the front of the shin may progress to a more significant problem.

Force

- Pressing down with force on a foot pedal while the ankle is bent leads to increased loading on the plantar fascia.

INDIRECT RISK FACTORS

Workstation Design

Working Heights

- Loading on the plantar fascia is increased when the height of the foot pedals requires a Bulldozer Operator to maintain a bent ankle to repeatedly activate foot pedals.

CONSEQUENCES

- Repeated use of foot pedals can cause damage to the tissues in the shin.
- Signs and symptoms include inflammation, and pain with walking.
- Continual use of foot pedals may cause damage to the plantar fascia.
- Signs and symptoms include pain and stiffness at the base of the heel, initially in the morning. As the problem progresses the pain may become chronic.

SUGGESTED SOLUTIONS

- For specific solutions that may prevent injuries to the Ankle/Foot, please see the columns labelled “Ankle” and “Foot” in the Summary of Solutions on pages 87 to 89.
- For exercises that can help to prevent *foot* injuries, see the *Foot section of the Body Manual*.

Summary of Body Parts at Risk

NECK

- Bulldozer Operators may repeatedly twist their neck to view their surroundings while operating a bulldozer.



NECK/SHOULDER

- Bulldozer Operators may continuously hold their arms away from their body in order to use lever controls.



WRIST/HAND

- Bulldozer Operators may continuously grip controls with their wrists bent in order to manoeuvre the bulldozer. When using controls, a Bulldozer Operator may be exposed to hand/arm vibration.



Low Back

Bulldozer Operators may bend forward and apply excessive force to manually adjust the position of the blade.



Bulldozer Operators sit continuously in vibrating machinery. Driving over uneven terrain increases the effect of vibration on the spine.



ANKLE/FOOT

- Bulldozer Operators frequently activate foot pedals in order to operate the bulldozer.



Risk Factors by Body Part

Direct Risk Factors	Neck	Neck/ Shoulder	Shoulder	Elbow/ Wrist	Wrist	Wrist/ Hand	Low Back	Hip	Knee	Ankle/ Foot	Foot
Force							✓			✓	
Repetition	✓	✓				✓				✓	
Awkward Posture	✓	✓				✓	✓			✓	
Static Posture		✓					✓			✓	
Contact Stress											
Vibration – Whole body*							✓				
Vibration – Hand Transmitted*						✓					

Indirect Risk Factors		Neck	Neck/ Shoulder	Shoulder	Elbow/ Wrist	Wrist	Wrist/ Hand	Low Back	Hip	Knee	Ankle/ Foot	Foot
Duration*	Duration	✓	✓				✓	✓			✓	
Workstation Design	Working Reaches		✓									
	Working Heights										✓	
	Seating							✓				
	Floor Surfaces											
Characteristics of Objects Being Handled	Size and Shape											
	Load Condition and Weight Distribution											
	Container, Tool and Equipment Handles						✓					
Environmental Conditions	Heat Exposure	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
	Cold Exposure	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
	Lighting	✓◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
	Noise	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
	Vibration**	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Work Organisation	Work-Recovery Cycles	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
	Task Variability	◆	◆	◆	◆	◆	◆	✓◆	◆	◆	◆	◆
	Work Rate	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆

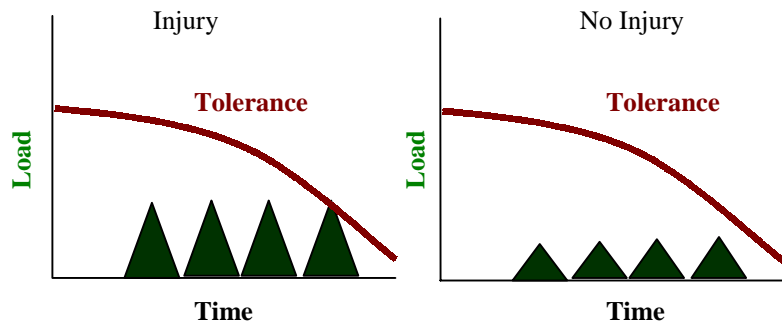
* Extended exposure to any risk factor can increase the likelihood of injury. For solutions designed to decrease the duration of exposure to any risk factor please refer to the Work Organisation section of the General Risk Factor Solutions Manual

** Vibration is categorised under both direct and indirect risk factors. Vibration can directly increase the likelihood of injury to the back and wrist as well as indirectly (environmental conditions) promote injuries in other parts of the body.

- = Indicates that the risk factor was assessed and was not found to be a contributor to the body part problem.
- ◆ = Indicates that the risk factor assessed is commonly found in sawmills, and may need to be addressed at your mill. See the appropriate section of the General Risk Factor Solutions Manual for more information.
- ✓ = Indicates that the risk factor was assessed as a contributor to the body part problem. Please see the Summary of Solutions Table on pages 87 to 89 for specific problem/solution information. Additional information on some risk factors can be found in the General Risk Factor Solutions Manual.

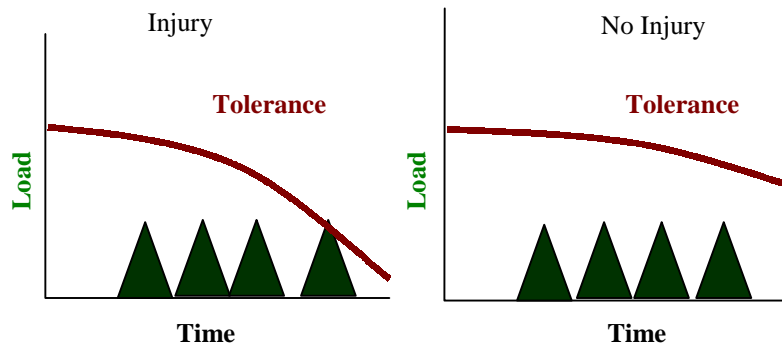
Injury Prevention

*Injuries are prevented by ...
Decreasing loads and increasing tissue tolerances*



Injuries may be avoided by decreasing the size of the loads on the tissue.

Example – using a torque multiplier wrench to loosen bolts.



Injuries may be avoided by increasing tissue tolerances, and allowing the body to endure more loading.

Example – using maintenance exercises to strengthen tissues.

Suggested Solutions

The previous page explains how injuries may be prevented by decreasing the load on a tissue or by increasing the tissue tolerances. The Injury Prevention section of the Work Manual provides possible solutions that can be implemented to decrease the size of the loads on the tissues.

Each of the solutions described in the Work Manual has a risk control icon. The Risk Control Key provides guidelines on how to distinguish between different types of risk controls. Generally, engineering, administrative, and work practice controls are considered more effective than the use of personal protective equipment to decrease the risk of musculoskeletal injuries.

The focus of the Injury Prevention section is on solutions developed following the ergonomic investigation of the Bulldozer job. The solutions are presented under the headings of Workstation Design, Characteristics of Objects Being Handled, Environmental Conditions, and Work Organisation.

The Summary of Solutions table provides a quick reference guide to solutions for specific body part problems.

Please note that the information provided in the Body Manual addresses the issue of injury prevention in terms of increasing tissue tolerances through exercise. This information is not provided in the Work Manual.

Risk Control Key

Risk control measures (solutions) are commonly grouped into four categories:

E

ENGINEERING CONTROLS

These include physical changes to workstations, equipment, materials, production facilities, or any other relevant aspect of the work environment, that reduce or prevent exposure to risk factors.

A

ADMINISTRATIVE CONTROLS

These include any change in procedure that significantly limits daily exposure to risk factors, by control or manipulation of the work schedule or manner in which work is performed. Administrative controls include, but are not limited to, job rotation, rest breaks, alternative tasks, job enlargement, redesign of work methods, and adjustment of work pace or output. Some models of risk control include work practice controls within this category.

WP

WORK PRACTICE CONTROLS

These include techniques used to perform the tasks of a job, such as reaching, gripping, using tools and equipment, or discarding objects, etc. Education and training are an integral part of work practice controls.

PPE

PERSONAL PROTECTIVE EQUIPMENT

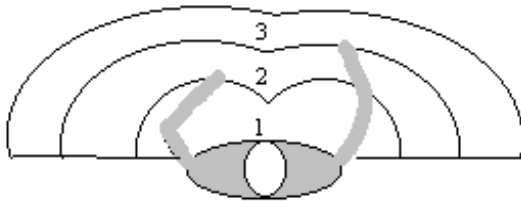
These are devices worn by a worker to reduce the risk of injury, including gloves, kneepads, hearing protection, and leather aprons.

On the following pages, the icons next to the solution options indicate the type of risk control.

Workstation Design

WORKING REACHES

A working reach that is too far for the worker will require stressful shoulder, elbow, wrist, and back postures. Reaching to the side, behind, or too far in front of the body can put stress on the smaller muscles. Ideally, working reaches should be within a normal reach envelope, as laid out below, with the controls and materials that are handled most often closest to the body. It is also ideal to have controls that perform similar or combined functions grouped together to decrease awkward postures that may otherwise occur.



- | |
|--|
| 1 = Controls/items most frequently used |
| 2 = Controls/items less frequently used |
| 3 = Controls/items least frequently used |

Generally, the most frequently used items should be placed within a forearm's reach, with less frequently used items placed within a comfortable arm's reach, and infrequently used items placed within a fully extended arm's reach. For more specific recommendations on working reaches, please consult anthropometric tables or an ergonomist.

Control distance

E
WP In order to reduce loading on the neck, shoulder, and back keep controls close to the body by moving the seat forward on slide tracks and/or extending controls into safe reach envelopes. This adjustability is important to accommodate operators of different sizes.

Good driving posture

WP In order to reduce loading on the neck and back, encourage workers to adopt good driving postures. Place back against the backrest, and avoid a static head forward posture where the head and eyes are continually pointed down at ground level work.



Slouching while driving.



Good driving posture.

Research mobile equipment with operators

A Operators can effectively identify potential challenges with awkward and static postures through an equipment trial period prior to purchasing. Most equipment dealers support such a trial period. Investigating mobile equipment with Bulldozer Operators will minimise the need to retrofit equipment.

WORKING HEIGHTS

A working height that is too high for the worker will require stressful shoulder and arm postures, while a height that is too low will require stressful bending of the neck and trunk. The height of a work surface should allow room to change position and move the legs and feet (WCB Draft Ergonomic Regulations, 1994).

The ideal workstation is height adjustable, allowing a large percentage of the population to adjust the work surface height to suit their dimensions

To determine the appropriate work height specific for the Bulldozer Operator, identify the body part of most concern. If the main concern is the:

Neck - minimise forward bending of the neck by increasing working height.

Shoulders - minimise elevation of the arms by lowering working height.

Low Back - minimise forward bending of the back by increasing working height.

For more specific guidelines on matching the working heights with the tasks performed please consult anthropometric tables or an ergonomist.

Arm supports

E

In order to reduce awkward and static postures of the neck/shoulder when operating controls, consider the height of the controls and arm supports. An operator's elbows and forearms should sit comfortably on the arm supports with the shoulders relaxed and the wrists free for using controls. Arm supports that are well-padded and height-adjustable, independent of the height of the seat, are preferred. The support provided by these arm supports reduces muscle tension and fatigue in the neck and shoulder.



Older style direction controls without arm supports



Newer style direction controls with armrest

WP

Bulldozer Operators should be encouraged to use the arm supports to relax the muscles in the neck/shoulder region when there is a break in the workload. Placing the elbows, forearms, and wrists on the arm supports while taking these microbreaks will allow working muscles to recover and repair.

Stepping down

WP

To significantly reduce loading on the back, avoid jumping down from equipment. After prolonged exposure to vibration in a static posture, the spine is more susceptible to an acute injury resulting from the impact of jumping down.

Ensure that you have secure foot and hand placement as you lower yourself off the machinery. Safe locations for foot placement should be well-marked.



Climbing into cab

E

WP

Handholds should be low enough so operators do not find it necessary to jerk themselves upward. This motion can place large loads on the shoulders when they are in a flexed position.

SEATING

Bulldozer Operators are required to sit. Sitting for long periods of time increases the load on the spine, which stresses the ligaments and discs of the low back. The load is increased when the Bulldozer Operator does not maintain a neutral spine (see Injury Education for the Low Back on page 58).

Lumbar support

E

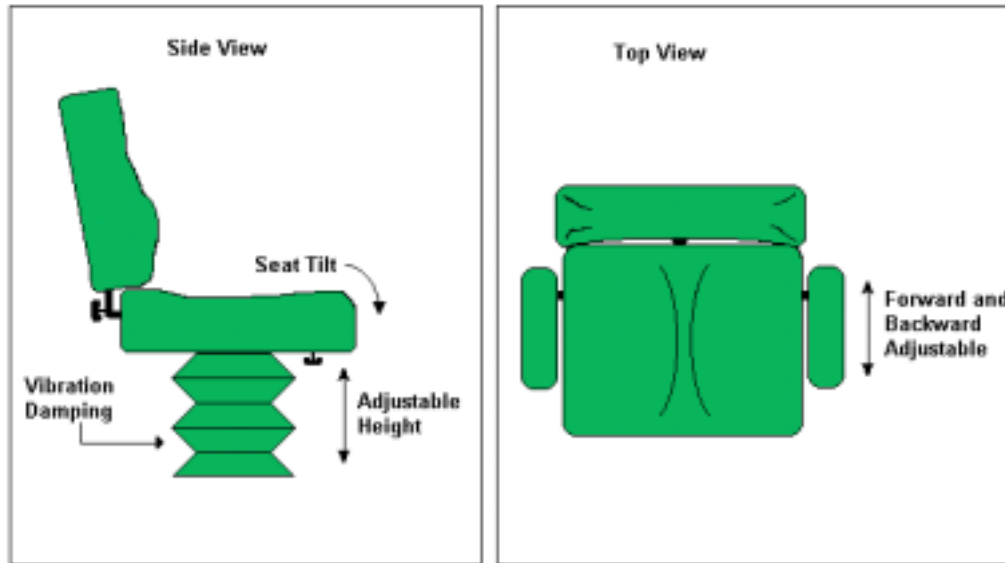
To improve the posture of the low back, install seats with good lumbar support. Seats that wrap around the low back and encourage proper posture, helping to maintain the curve of the lower back, have good lumbar support.



Adjustable seating

E
WP

In order to minimise awkward and static postures of the low back, seating should have several adjustable features to accommodate various operators, and allow for continual postural adjustments.



- ★ Seating should have adjustable lumbar support
- ★ Seats should be adjustable forward/backward and up/down
- ★ Seats should have seat pans which tilt forward and backward
- ★ Seats should be air-ride, or have vibration damping cushions
- ★ Seats should be covered with a breathable, non-slip material

Vary body posture

WP

In order to reduce awkward and static postures in the low back, get up from the seated posture throughout the day (micro-breaks). This change in posture alleviates the load on the spine, allows the discs to equalise, and allows ligaments to regain their stiffness after being stretched out from sitting.

Seat maintenance

E
A
WP

Vehicle seats and supports are the only layer of protection between an operator and the whole-body vibration transmitted from mobile equipment. In many cases, the seat also provides the only suspension between the user and the vibration and impact from rough terrain. For these reasons, seats need to be properly maintained to help prevent injuries.

Seat maintenance should begin when a new piece of mobile equipment is being ordered. Many equipment manufacturers offer a selection of seats. Use the information on the previous page to select a seat that satisfies your ergonomic criteria. Where possible, have the intended operators try several different seat styles before deciding on a seat design. If the manufacturer does not offer seats of suitable quality, it might be necessary to order a custom seat. Remember: heavy equipment manufacturers do not specialise in ergonomic seat design. Good quality seats may require separate ordering and installation.

Any new seat should come with a clear set of instructions for adjustment and use. Photocopy a set of these instructions for each operator, and laminate another copy for prominent storage in the vehicle cab. Make sure all operators are familiar with the purpose and use of all seat features.

Regular seat maintenance

Regular vehicle seat maintenance should follow a schedule based on duration of use, similar to engine maintenance. At the prescribed time, all components of the seat should be inspected for wear, and damaged parts should be replaced. This inspection should include seat suspension, seat cushioning, seat covering, and arm supports. Seats should be replaced when they are too worn, or when they can no longer be repaired to safe working levels. Seats, like work boots, have a lifespan limited by their daily exposure to vibration, shock impact, and continuous load bearing.

Daily inspection of seat

Seat users should also be responsible for ongoing maintenance. A short daily inspection of the vehicle seat could identify wear or damage before it becomes a major problem. Keeping the seat and cab as clean as possible and regularly using all adjustments on the chair can also help to minimise uneven wear and prevent damage.

Adjust seat spring

WP In order to reduce vibration transmitted to the low back, operators should adjust seat spring to an appropriate level.



Some Bulldozers have spring-damped seats. If the seats are too stiff more vibration may be transmitted from the seat to the back.

Seat belts

WP In order to improve the posture of the low back, encourage the operator to use a seat belt.



Safety regulations state that vehicle operators have to wear a seat belt. These seat belts can also be useful in helping to maintain lumbar curve by holding the low back against the seat and avoiding slouching.

ADDITIONAL WORKSTATION DESIGN OPTIONS

Equipment maintenance

- A In order to reduce loading on the back from whole body vibration, maintain the machine properly and allow the machine to warm-up before using it.

Force to activate foot pedals

- E To reduce loading on the ankle, decrease the force required to activate foot pedals. It is important to ensure pedals are kept clean of debris and are well-maintained.



Foot pedals and floor areas should be free of obstruction.

Angle of foot pedal

- E To reduce loading on the ankle, decrease the angle of the foot pedal.



Foot pedals with a vertical surface place more loading on the ankle.



Horizontal foot pedals require less ankle flexion to operate.

Foot pedal maintenance

E
A To reduce loading on the knee from activating foot pedals, remove debris under the pedals, and lubricate the rockers on the pedals to ensure they move freely.

To reduce the force required to maintain foot contact and activate foot pedals, maintain the rubber covering on the pedal.

Foot placement on foot pedal

WP To reduce loading on the ankle, use the ball of the foot to activate the pedal. Activation on the lower portion of the pedal or using the tip of the foot increases the force required to operate.



*Good Technique:
Using the ball of the foot to activate the foot pedal.*



*Poor Technique:
Using the tip of the foot to activate the foot pedal.*

Proper-fitting shoes or boots

PPE When operating pedals for long duration, try to wear boots with more flexibility in the ankle region. Safety shoes or boots with shorter ankle supports allow for easier movement of the ankle and foot, decreasing muscle fatigue.

Window cleaning

A

To improve visibility and awkward neck postures, clean windows regularly. Hinged window caging can be opened to make cleaning more convenient.

Use mirrors to view blade

E
WP

To reduce awkward postures of the neck, install mirrors to help view the blade while positioning. These mirrors will need to be firmly positioned and regularly tightened to make sure they are focused on the blade.



Additional Work Practices

Hourly stretch breaks

WP

In order to improve the body's tolerance for work, encourage Bulldozer Operators to take stretch breaks every hour. Stretches should be done with the vehicle off and safely parked. Make sure that the ground is flat and dry for personal safety. Suggested stretches are listed below.



To help relax back muscles, stretch the low back by hanging off the equipment. Place feet at 45 degrees and bend the knees, keeping the low back straight. This will stretch one side of the back. Alternate sides.



To improve the posture of the low back when driving, stretch the back of the legs by putting one foot on the bucket. Keep the back straight and bend at the hips. Stretch each leg for 30 seconds after each hour of work.



To help relax neck muscles, stretch the neck for 30 seconds each side after every hour of driving. Reach for the ground or hold onto equipment and turn head slightly to the side. Stretch by lowering the head. Avoid overstretching.

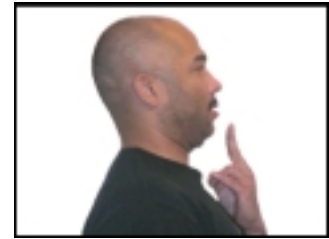


To reduce loading on the neck from poor posture, perform the wall exercise 4 times for 15 seconds after every hour of driving. Re-align the spine by placing the feet out from the wall, and flattening the low back against the wall. Bend the elbows to 90 degrees, with the hands and wrists above shoulder height. Press the forearms back against the wall. Keep chin tucked in.

When time permits these stretches would complement the suggested hourly stretches.

Chin Tuck

With your head upright, tuck chin in. You should feel a gentle stretch, in the back of the neck. Hold for 20 seconds and then relax. Repeat 3 times.



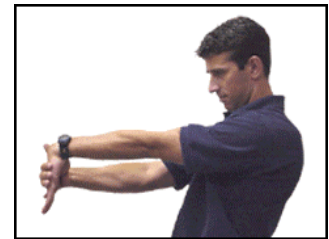
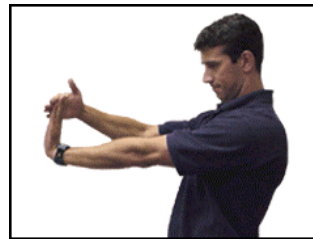
Shoulder Stretch

Gently pull elbow towards opposite shoulder, keeping both shoulders relaxed. You should feel a mild stretch in the back of the shoulder. Hold for 5 seconds. Repeat with the other arm.



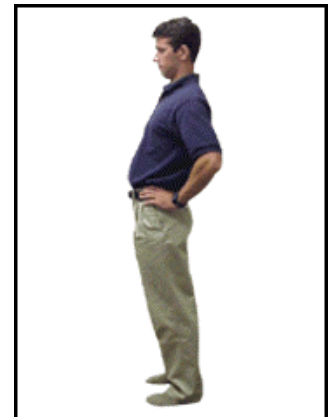
Wrist Flexor and Extensor Stretch

With your arm extended and fingers pointing up, gently pull hand towards your body until you feel a mild stretch in the forearm. (**Note:** do not stretch to the point where you feel pain or tingling). Hold for 15 – 30 seconds. Repeat with fingers pointing down. Repeat with the other arm.



Back Extension

Start by standing in an upright position (the back is in neutral posture). Lean backwards slightly, pushing the hips gently forward. Hold for 5 seconds. Repeat 3 times.



Alternate looking over shoulders

WP To avoid muscle imbalance in the neck and shoulders, try to alternate looking over each shoulder while driving backwards.



Characteristics of Objects Being Handled

SIZE AND SHAPE

Lever controls

E

In order to minimise contact stress on the hands controls should have cylindrical rather than ball shaped handles. This would allow for a more even distribution of contact with the lever. Grips should be made of a material that allows for good contact and is not slippery (e.g., bike handle foam coverings). Regardless of the shape of the lever control, the wrist should remain in a neutral position as often as possible.



Contoured lever grips are preferred to reduce contact stress and promote neutral wrist postures.



Hard lever handles can lead to contact stress.

CONTAINER, TOOL AND EQUIPMENT HANDLES

Maintain neutral postures

WP



In order to reduce awkward postures of the wrist maintain a neutral posture (straight wrist) whenever possible while operating lever controls.

Padding for levers

E

To minimise contact stress to the wrist/hand, provide some padding to the area to be gripped by the operator.

Gloves

PPE

In order to reduce grip forces required by the Bulldozer Operator, the operator should wear thin, close fitting gloves with a “sticky” palm surface to increase the friction between the gloves and control levers. For open-cab bulldozers, well-insulated work gloves may be required for winter work.

Environmental Conditions

Flood lighting

E

To improve visibility at night, install high-power floodlights on the front and back of the bulldozer to ensure adequate lighting. External floodlights on frequent work areas (e.g., log yard, gravel depot) can also improve visibility.



Winter clothing

PPE

In order to reduce loading on the wrists from overgripping, Bulldozer Operators should be encouraged to wear proper winter clothing, including well-insulated gloves, when working in cold temperatures.

Reduce glare

PPE

To minimise awkward neck postures due to glare, operators may wear sunglasses, or windows can be treated to filter sunlight.

Work Organisation

Task variability

A WP

In order to reduce exposure to risk factors associated with Bulldozer Operators, workers should vary tasks throughout their shift. Taking short breaks just to get out of the cab and stand will help to re-align the spine.

Please refer to the General Risk Factor Solutions Manual for solutions regarding Environmental and Work Organisation risk factors.

Summary of Solutions

Refer to the table below to help determine which solution alternatives will aid in addressing risk factors in the particular body parts of concern.

SOLUTIONS	Page	Injury Prevention Potential										
		Neck	Neck/ Shoulder	Shoulder	Elbow/ Wrist	Wrist	Wrist/ Hand	Low Back	Hip	Knee	Ankle/Foot	Foot
Control distance	69		A					A				
Good driving posture	69	A						A				
Research mobile equipment with operators	69	R A	R A S				R A V	F A S V			F R A S	
Arm supports	71		A S									
Stepping down	72							V				
Climbing into cab	72			F								
Lumbar support	73							A				
Adjustable seating	74							A S				
Vary body posture	74							A V				
Seat maintenance	75							A V				
Adjust seat spring	76							V				
Seat belts	76							A				
Equipment maintenance	77							V				
Force to activate foot pedals	77										F	

Direct Risk Factors

F = Force

R = Repetition

A = Awkward Posture

S = Static Posture

C = Contact Stress

V = Vibration

Summary of Solutions

Refer to the table below to help determine which solution alternatives will aid in addressing risk factors in the particular body parts of concern.

		Injury Prevention Potential										
SOLUTIONS	Page	Neck	Neck/ Shoulder	Shoulder	Elbow/ Wrist	Wrist	Wrist/ Hand	Low Back	Hip	Knee	Ankle/ Foot	Foot
Angle of foot pedal	77										A F	
Foot pedal maintenance	78										F	
Foot placement on foot pedal	78										F	
Proper-fitting shoes or boots	78										A F	
Window cleaning	79	A										
Use mirrors to view blade	79	A										
Hourly stretch breaks	80	R A	R A S				R A V	F A S V			F R A S	
Alternate looking over shoulders	82	R A										
Lever controls	83						A					
Maintain neutral posture	83						A					

Direct Risk Factors

F = Force

S = Static Posture

R = Repetition

C = Contact Stress

A = Awkward Posture

V = Vibration

Summary of Solutions

Refer to the table below to help determine which solution alternatives will aid in addressing risk factors in the particular body parts of concern.

		Injury Prevention Potential										
SOLUTIONS	Page	Neck	Neck/ Shoulder	Shoulder	Elbow/ Wrist	Wrist	Wrist/ Hand	Low Back	Hip	Knee	Ankle/ Foot	Foot
Padding for levers	84						C					
Gloves	84						F					
Flood lighting	85	A										
Winter clothing	85						F					
Reduce glare	85	A										
Task variability	86	A S	R A S				R A S V	F A S V			A S	
Heat Exposure	♦	indirectly reduces risk of injury to the body										
Cold Exposure	♦	indirectly reduces risk of injury to the body										
Lighting	♦	indirectly reduces risk of injury to the body										
Noise	♦	indirectly reduces risk of injury to the body										
Vibration	♦	directly reduces risk of injury to the back and wrist										
Rest breaks	♦	indirectly reduces risk of injury to the body										
Job Rotation	♦	indirectly reduces risk of injury to the body										
Task Rotation	♦	indirectly reduces risk of injury to the body										
Work Pace	♦	indirectly reduces risk of injury to the body										
Scheduling	♦	indirectly reduces risk of injury to the body										

Direct Risk Factors

F = Force

R = Repetition

A = Awkward Posture

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♦ = See General Risk Factor Solutions Manual

BULLDOZER OPERATOR MSI SAFETY GUIDE

OBJECTIVE: To identify ergonomic risks involved in Bulldozer Operator and to reduce the potential for musculoskeletal injuries. More detailed information about risk reducing recommendations can be found in the Work Manual for the Bulldozer Operator.

CHECK IF THIS APPLIES	ACTIVITY OF RISK	DIRECT RISK FACTOR(S)	POTENTIAL HAZARDS	SUGGESTED SOLUTIONS
	<p>Neck</p> <p>Bulldozer Operators may repeatedly twist their neck to view their surroundings while operating a bulldozer.</p>	<p>Awkward Posture</p> <p>Repetition</p>	<ul style="list-style-type: none"> • Neck muscles are required to turn the head to the side. The further the head is turned to the side, the greater the load on the muscles and tendons. • When the head is repeatedly turned to the side, the muscles of the neck are subjected to repeated stress with little time for recovery. If the repetitive stress is excessive, and recovery is not adequate, the tissues can fatigue to the point of injury. 	<ul style="list-style-type: none"> • Alternate looking over both shoulders when driving backwards. • Clean windows regularly. • Stretch neck to relax neck muscles after extended periods of driving. Reach for the ground or hold onto equipment and turn head slightly to the side. Lower the head to stretch. Avoid overstretching. • Re-align the spine by placing the feet out from the wall, and flattening the low back against the wall. Place the arms at 90 degrees and press the forearms back against the wall. Keep chin tucked in. Perform the wall exercise for 15 seconds four times after every hour of driving. • For exercises that can help prevent <i>Neck</i> injuries, <i>see the Neck section of the Body Manual.</i>

CHECK IF THIS APPLIES	ACTIVITY OF RISK	DIRECT RISK FACTOR(S)	POTENTIAL HAZARDS	SUGGESTED SOLUTIONS
	<p>Neck/Shoulder</p> <p>Bulldozer Operators may continuously hold their arms away from their body in order to use lever controls.</p>	<p>Awkward Posture</p> <p>Static Posture</p> <p>Repetition</p>	<ul style="list-style-type: none"> • Neck and shoulder muscles must support the weight of the arms when they are away from the body. The farther away the arms are from the body, the greater the load on the muscles and tendons. • When the arms are repeatedly held away from the body, the muscles of the neck and shoulder must remain tense to support the weight. If the duration of constant tension is excessive, and recovery is not adequate, the tissues may fatigue to the point of injury. • When the arms are repeatedly lifted, the muscles of the neck and shoulder are subjected to repeated stress with little or no time for recovery. If the repetitive stress is excessive, and recovery is not adequate, the tissues may fatigue to the point of injury. 	<ul style="list-style-type: none"> • Avoid “resting” the hand on controls or gearshift. Use armrests - when properly adjusted they keep the shoulder in a more neutral position • Adjust the distances between the seat and driving controls. Position yourself to allow for neutral or near neutral postures of the shoulders. The shoulders should be relaxed and the elbows close to the body. • Use tilt steering features, where available, to move the steering wheel closer to the body. • To stretch the shoulder, hang onto the machine and turn the body until a gentle stretch is experienced in the back part of the shoulder. • For more exercises that can help prevent <i>Neck</i> and <i>Shoulder</i> injuries, <i>see the Neck and Shoulder sections of the Body Manual.</i>

CHECK IF THIS APPLIES	ACTIVITY OF RISK	DIRECT RISK FACTOR(S)	POTENTIAL HAZARDS	SUGGESTED SOLUTIONS
	<p>Wrist/Hand</p> <p>Bulldozer Operators may continuously grip controls with their wrists bent in order to manoeuvre the bulldozer. When using controls, a Bulldozer Operator may be exposed to hand/arm vibration.</p>	<p>Awkward Posture</p> <p>Repetition</p> <p>Vibration</p>	<ul style="list-style-type: none"> • As the wrist is bent, the tendon sheaths will rub up against the walls of the carpal tunnel. The further the wrist is bent, the more friction experienced in the tendon sheaths. • Repeated gripping and/or repeated bending of the wrist causes stress to the tendon sheaths. If the repetitive stress is excessive, and recovery is not adequate, the tendon sheaths may fatigue to the point of injury. • Exposure to vibration through contact with vibrating objects places unique form of mechanical stress on the tissues of the hand and wrist. Factors like vibration level and vibration frequency influence the amount of mechanical stress. • Continual exposure to hand/arm vibration may gradually damage neurovascular tissue (nerves and blood vessels) in the hand, and may contribute to problems in the wrist. 	<ul style="list-style-type: none"> • Maintain neutral wrist postures when operating controls. • Release the hand from the controls whenever it is possible. • Sit back and use armrests when there is a break in the workflow. • Protect the base of the hand - try to keep minimise contact stress in this area. • Operators should be encouraged to wear proper winter clothing, including well-insulated gloves, to reduce over-gripping. • For exercises that can help prevent Wrist injuries, <i>see the Wrist section of the Body Manual.</i>

CHECK IF THIS APPLIES	ACTIVITY OF RISK	DIRECT RISK FACTOR(S)	POTENTIAL HAZARDS	SUGGESTED SOLUTIONS
	<p>Low Back</p> <p>Bulldozer Operators may have to bend forward and apply excessive force to manually adjust the position of the blade.</p>	<p>Force</p> <p>Awkward Posture</p>	<ul style="list-style-type: none"> Forceful pushing/pulling increases the loading on the spine. The greater the weight of the object, the greater the loading on the structures on the low back. Back muscles must support the weight of the upper body when leaning forward. Increased bending of the back increases the loading on the spine and increases the pressure on the walls of the discs. 	<ul style="list-style-type: none"> Remember to wear your seatbelt, both for safety and as a reminder to improve posture. Control Bulldozer speed to reduce exposure to whole body vibration. Know how to adjust your seat, including the suspension. Identify wear and damage of your seat before it becomes a major problem.
	<p>Bulldozer Operators sit continuously in vibrating machinery. Driving over uneven terrain increases the effect of vibration on the spine.</p>	<p>Awkward Posture</p> <p>Static Posture</p> <p>Vibration</p>	<ul style="list-style-type: none"> Sitting increases the loading on the walls of the discs. If the duration of sitting is excessive, and the recovery is not adequate (e.g., spine not returned to neutral posture), the tissues may deform to the point of injury. Whole body vibration is usually transmitted through the seat into the low back. Exposure to whole body vibration introduces a unique mechanical stress to the structures of the spine that can significantly increase the loading on the low back. Prolonged sitting on a vibrating surface may contribute to the gradual weakening of the lumbar discs. 	<ul style="list-style-type: none"> When getting out of the cab, climb down instead of jumping down. Jumping down from the cab, particularly after a long period of driving, can cause injury because the prolonged seated posture has already stressed the tissues of the low back. Get up from the seated posture throughout the day, and stretch when possible. This alleviates the load on the spine, allows the discs to equalise, and allows ligaments to regain their stiffness after being stretched out from sitting.

CHECK IF THIS APPLIES	ACTIVITY OF RISK	DIRECT RISK FACTOR(S)	POTENTIAL HAZARDS	SUGGESTED SOLUTIONS
	<p>Low Back (continued)</p>			<ul style="list-style-type: none"> • To help relax back muscles, stretch the low back while hanging onto the equipment. Place feet at 45 degrees and bend the knees, keeping the low back straight. This will stretch one side of the back. Alternate sides. • To improve driving posture, stretch the back of the legs. Put one foot on a raised surface. Keep the back straight and bend at the hips. Stretch each leg for 30 seconds. • For more exercises that can help prevent Back injuries, <i>see the Back section of the Body Manual.</i>

CHECK IF THIS APPLIES	ACTIVITY OF RISK	DIRECT RISK FACTOR(S)	POTENTIAL HAZARDS	SUGGESTED SOLUTIONS
	<p>Ankle/Foot</p> <p>Bulldozer Operators frequently activates foot pedals in order to operate the bulldozer.</p>	<p>Awkward Posture</p> <p>Static Posture</p> <p>Repetition</p> <p>Force</p>	<ul style="list-style-type: none"> • Lifting the foot to activate a foot pedal puts the ankle into an awkward posture, which increases the loading in the muscle on the front of the shin. The further away from the neutral posture the ankle is, the greater the loading to this muscle. If the shoes worn are rigid or heavy, the loading is also increased. • Continual pressure on foot pedals can cause tissue in the foot to deform and breakdown over time. If the tissue deformation is excessive and recovery not adequate, an injury may occur. • Repetitive use of foot pedals may gradually cause small tears in the muscle on the front of the shin. If the repetitive stress is excessive, and recovery is not adequate, the small tears in the muscle on the front of the shin may progress to a more significant problem. • Pressing down with force on a foot pedal while the ankle is bent leads to increased loading on the plantar fascia. 	<ul style="list-style-type: none"> • Place the foot properly on the pedal. Activation on the lower portion of the pedal or using the tip of the foot increases the force required to operate. • Remove debris from under foot pedals, and lubricate the rockers on pedals to ensure they move freely, reducing loading on the ankle. • Avoid jumping down from the bulldozer. • When operating pedals for long duration, try to wear boots with more flexibility in the ankle region. Safety shoes or boots with shorter ankle supports allow for easier movement of the ankle and foot, decreasing muscle fatigue. • Stretch the ankles before and during work to make sure they are loose. • For exercises that can help prevent <i>Ankle/Foot</i> injuries, <i>see the Foot section of the Body Manual</i>.