

TASK ANALYSIS WORKSHEET

Company: The Corporation of DeltaDepartment: Engineering OperationsJob Title: Equipment Operator III (Sweeper)Date: April 16 / 23, 2003**Job Summary:**

The Sweeper Operator is primarily responsible for sweeping roads throughout the Delta area. Personal protective equipment include: safety boots and coveralls. There are a total of 2 Sweepers – Elgin GMC #2073 & Elgin Crosswind. The newer model is Elgin GMC #2073. The two sweepers allow for both right-hand and left-hand driving.

The operator stated that the time spent sitting on each side (i.e. left side vs. right side) varies from day to day. The operator estimated that he drives on the right side 60% of the time and on the left side ~40% of the time. For safety reasons, operators have been instructed to sit on the left side when: i) driving from location to location (i.e. when not sweeping); and ii) when sweeping medians (which are located on the left).

This assessment includes the following tasks (and the Sweeper it was assessed on):

1. Parking Brake (Elgin GMC #2073)
2. Lifting Hood during pre-trip inspection (Elgin GMC #2073)
3. Filling water tank using a hydrant (Elgin GMC #2073)
4. Cleaning truck using water hose (Elgin Crosswind)

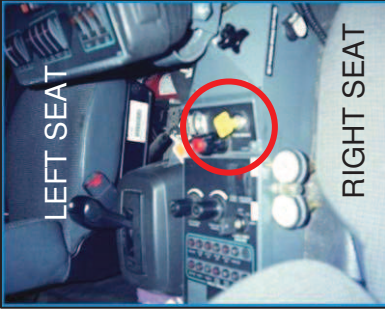
Other Notes:

- The purpose of this assessment was to assess specific tasks that require force exertions with the shoulder. As a result, NOT all tasks performed by the Sweeper Operator were assessed (e.g. driving, operating the control panel).
- N.B.: This assessment was based on a working population of males only.

Tasks & Description of Activities

1. Parking Brake (Elgin GMC #2073)

- Parking brake is an air brake and is applied each time the operator gets out of the cab.
- The parking brake, which can be applied / released from the left seat or the right seat, requires a pull (to apply the air brake) and a push (to release the air brake).



Parking Brake location (shown in red)

Pull parking brake from RIGHT seat

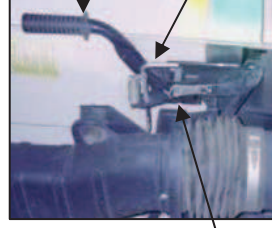
2. Lifting Hood during Pre-trip Inspection (Elgin GMC #2073)

Steps to raise hood:

- i. Release safety pin – no forces required
- ii. Pull down cab lock
- iii. Pull back release cab lock
- iv. Raise / lift hood

Steps to close hood:

- i. Squeeze safety pin under hood } done
- ii. Lower / pull down hood } simultaneously
- iii. Lift cab lock
- iv. Position safety pin



Cab lock

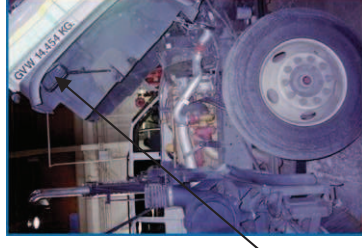
Release cab

Safety pin



Safety pin (under hood)

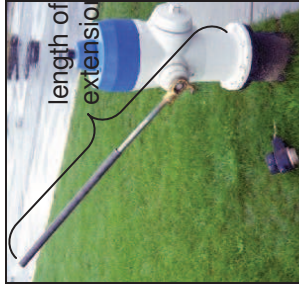
Handle to lift / lower cab



Tasks & Description of Activities

3. Filling water tank using a hydrant (Elgin GMC #2073)

- i. Remove tools (independent gate valve, hydrant key, extension) from tool box
- ii. Loosen cap using hydrant key (+ extension)
- iii. Remove cap by hand (after loosening with tools)
- iv. Hand-tighten independent gate valve onto hydrant. Independent gate valve releases the water.
- v. Tighten independent gate valve onto hydrant using hydrant key (+ extension)
- vi. Open hydrant using hydrant key (+ extension)
- vii. Secure water hose to independent gate valve using hydrant key (+ extension)
- viii. Fill water tank on sweeper
- ix. Loosen water hose using hydrant key (+ extension)
- x. Close the hydrant using hydrant key (+ extension)
- xi. Loosen independent gate valve using hydrant key (+ extension)
- xii. Secure cap onto hydrant using hydrant key (+ extension). Operator stated that the cap does not have to be secured very tight – just enough so that it cannot be removed by hand.



Using hydrant key to loosen cap



Using hydrant key to open / close hydrant



Secure water hose to hydrant.

4. Cleaning truck using water hose (Elgin Crosswind)



Cleaning truck using hose

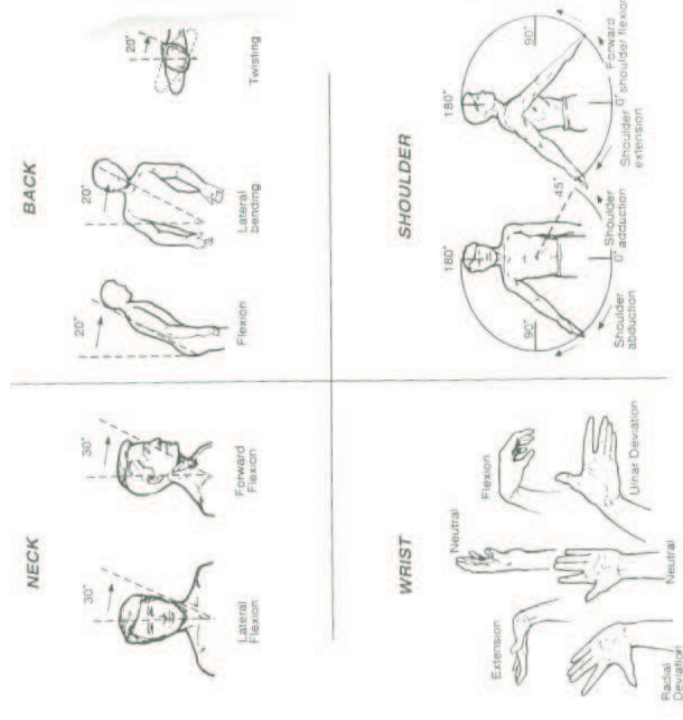
WWC

WorkWell Consulting

Ergonomic Risk Identification & Assessment

Risk Factors considered:

- Joint posture: wrist, elbow, shoulder, neck, back, knees
- Awkward posture: reach, twist, bend, stoop, squat, climb, static, dynamic
- Force: lift, lower, carry, push/pull, pinch or power grip
- Repetition: frequency, duration
- Contact Stress
- Object weight, location, size, shape, handles, stability of load
- Work height, layout, seating, space
- Tool/equipment use
- Environment: layout, flooring, temperature, noise, light, glare, vibration
- Work Organization: recovery, schedule, workload, task variability, pace, PPE use, interruptions



Postures, WCB of BC

Department/Work Area: Engineering Operations, Roads Traffic	Occupation: Equipment Operator III (Sweeper)
Specific Location: Delta (assorted)	Contact Name:
Assessed By: F. Ismail	Assessment Date: April 16, 2003

Description of work area: Outdoor roadside urban and industrial park location.
Hours of Work/Shift Schedule: 8:00 a.m. to 4:30 p.m.
MSI signs / symptoms noted: back, shoulder

Frequency percentages are based on NIOSH and Department of Labour guidelines.

Tasks for Ergonomics Risk Assessment (from Task Analysis worksheet):		Frequency / Duration of Task:
1. Parking Brake – Elgin GMC #2073		< 1 hour/day
2. Lifting hood during pre-trip inspection – Elgin GMC #2073		0-33% of shift
3. Filling water tank using a hydrant – Elgin GMC #2073		< 1 hour/day
4. Cleaning truck using water hose – Elgin Crosswind		0-33% of shift

The following tasks are described based on observations of the worker performing the tasks. Other workers may assume different body postures when performing the task.

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment/Observations/Comments
1. Parking Brake (Elgin GMC #2073)	Awkward Posture: Seated on <u>LEFT</u> side: <ul style="list-style-type: none"> Right shoulder abduction 45° Right elbow extended Slight lateral flexion of the back 	2-5 sec duration 0-33% of shift	Dynamic (<30 sec.) Reaches: <ul style="list-style-type: none"> lateral reach 56 cm vertical height – 38-48 cm below shoulder (depends on chair height) 	<p>Assessment</p> <ul style="list-style-type: none"> To pull / push the parking brake while seated on the LEFT side, the following postures are assumed: right shoulder abduction 45°, right elbow extended and a slight lateral flexion of the back. <p>The dynamic nature and frequency and duration of the tasks do not exceed ergonomic guidelines for awkward postures (WCB Worksheet B).</p>
	Awkward Posture: Seated on <u>RIGHT</u> side: <ul style="list-style-type: none"> Left shoulder abduction 15° Left elbow extended 160° 	2-5 sec duration 0-33% of shift	Dynamic (<30 sec.) Reaches: <ul style="list-style-type: none"> lateral reach 25 cm vertical height – same as LEFT side 	

To pull / push the parking brake while seated on the RIGHT side, the following postures are assumed: left shoulder abduction 15° and left elbow extended 160°.

The dynamic nature and frequency and duration of the tasks do not exceed ergonomic guidelines for awkward postures (WCB Worksheet B).

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment/Observations/Comments
<p style="text-align: center;">Identification</p> <p>Parking Brake (Elgin GMC #2073) ... continued</p>	<p>Force:</p> <ul style="list-style-type: none"> ▪ Pull parking brake ▪ Push parking brake 	<p>2-5 sec 0-33% of shift</p>	<ul style="list-style-type: none"> ▪ 9 kg pull ▪ 13 kg push 	<p>Assessment</p>
<p>Majority of the forces to push / pull the parking brake while seated at the LEFT side are exerted by the shoulder.</p> <p>Majority of the forces to push / pull the parking brake while seated at the RIGHT side are exerted by the elbow.</p> <p>While seated at the LEFT side: i) pulling the parking brake exceeds ergonomic guidelines (Mital, Nicholson & Ayoub, 1993). It should be noted that this guideline is a general one-handed lifting guideline (seated, infrequent lift) and, therefore, is not specific to this task which involves a lateral reach. Guidelines specific to pulling upwards while reaching laterally could not be found; and ii) pushing the parking brake – could not be determined if within guidelines. Again, guidelines specific to this scenario (i.e. pushing down while reaching laterally) were not found.</p> <p>While seated at the RIGHT side: i) pulling the parking brake is within ergonomic guidelines (Kodak, 1986, Putz-Anderson, 1988); and ii) pushing the parking brake exceeds ergonomic guidelines (Kodak, 1986, Putz-Anderson, 1988).</p>				

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
<p>2. Lifting hood during pre-trip inspection (Elgin GMC #2073)</p>	<p>Awkward Posture:</p> <ul style="list-style-type: none"> ▪ Shoulder flexion 90-180° ▪ Elbow extension 135-180° 	<p>2-5 sec duration 0-33% of shift (once per shift)</p>	<p>Dynamic (<30 sec.)</p>	<p style="text-align: center;">Assessment</p>	<p>TO LIFT HOOD:</p> <ul style="list-style-type: none"> ▪ Shoulder flexion 90° to release safety pin (ht. = 157 cm) ▪ Shoulder flexion 135° and elbow extended 135° to pull down cab lock (ht. = 175 cm) ▪ Shoulder flexion 95° and elbow extended 160° to pull back release cab (ht. = 160 cm) ▪ Initially, elbows flexed <90° to lift cab (ht. = 112 cm). At end of lift, shoulders flexed 180° and elbows extended 180° (ht. = 203 cm). <p>TO LOWER HOOD:</p> <ul style="list-style-type: none"> ▪ Simultaneously squeeze safety pin under hood (ht. = 122 cm, lateral reach = 69 cm) and begin lowering hood – shoulder flexion 180°, elbows extended 160° and lateral back flexion 30° <p>The dynamic nature and frequency and duration of the tasks do not exceed ergonomic guidelines for awkward postures (WCB Worksheet B). However, depending on the operator's body size, he may be unable to reach the handle of the hood (to lower it) while squeezing the safety pin.</p>

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
<p>Identification</p>	<p>Force:</p> <ul style="list-style-type: none"> ▪ Pull down cab lock ▪ Pull back release cab ▪ Lift and lower hood ▪ Squeeze safety pin (under hood) ▪ Pull / push up cab lock 	<p>2-5 sec 0-33% of shift (once per shift)</p>	<p>TO LIFT:</p> <ul style="list-style-type: none"> ▪ 8 kg to pull down cab lock ▪ 6.8 kg pull back on release cab ▪ lift hood up to 32 kg <p>TO LOWER:</p> <ul style="list-style-type: none"> ▪ squeeze safety pin 1.8 kg ▪ lower hood 36-45 kg ▪ pull / push up cab lock 10 kg 	<p style="text-align: center;">Assessment</p>	<p>TO LIFT:</p> <ul style="list-style-type: none"> ▪ Minimal forces required to release safety pin (< 1lb) ▪ Pull down cab lock – 8 kg (vertical pull down) ▪ Pull back on release cab – 6.8 kg (horizontal pull back) ▪ lift hood up to 32 kg (vertical pull up then push up) – can use 2 hands for this task <p>TO LOWER:</p> <ul style="list-style-type: none"> ▪ Squeeze safety pin (under hood) 1.8 kg (power grip squeeze) ▪ To lower hood, forces range from 36-45 kg – initially one-hand pull down then later, 2 hands can be used ▪ Pull up then push up cab lock – 10 kg <p>The following forces are within ergonomic guidelines: i) pull down cab lock (Kodak, 1986); ii) pull back on release cab (Mital, Nicholson & Ayouub, 1993); iii) squeeze safety pin under hood (Humanscale, 1981: Tab 4 Human Strength); and iv) pull / push up cab lock 10 kg (Kodak, 1986).</p> <p>The following forces exceed ergonomic guidelines: i) lift hood (Kodak, 1986); and ii) lower hood (Kodak, 1986).</p>

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment/Observations/Comments
<p>3. Filling water tank using a hydrant (Elgin GMC #2073)</p>	<p>Awkward Posture:</p> <ul style="list-style-type: none"> ▪ Squatting ▪ Back flexion 30-50° ▪ Shoulder flexion ▪ Elbow pronation ▪ Elbow extension 	<p>15-20 min duration</p> <p>0-33% of shift (once per shift)</p>	<p>Dynamic (<30 sec.)</p> <ul style="list-style-type: none"> ▪ squatting, back flexion, elbow pronation, elbow extension, shoulder flexion 	<ul style="list-style-type: none"> ▪ Squatting or back flexion to position / remove independent gate valve, cap, and water hose ▪ shoulder flexion and elbow extension to secure / remove above parts using hydrant key (+ extension) ▪ elbow pronation to open / close hydrant <p>The dynamic nature and frequency and duration of the tasks do not exceed ergonomic guidelines for awkward postures (WCB Worksheet B). Able to pause and take mini-breaks as required.</p>
	<p>Force:</p> <ul style="list-style-type: none"> ▪ Lifting assorted tools and parts ▪ Loosen cap ▪ Tighten / loosen independent gate valve ▪ Open / close hydrant ▪ Secure / loosen water hose 	<p>15-20 min duration</p> <p>0-33% of shift (once per shift)</p>	<ul style="list-style-type: none"> ▪ tools weigh 1.4 – 2.3 kg ▪ independent gate valve – 2.7 kg ▪ loosen cap – 1.8 kg ▪ tighten independent gate valve – 2.7 kg ▪ open / close hydrant – <2.3 kg ▪ secure water hose – 3.2 kg ▪ loosen water hose – 2.7 kg ▪ loosen independent gate valve – 2.7 kg 	<p style="text-align: center;">Assessment</p> <ul style="list-style-type: none"> ▪ Weight of hydrant key (2.3) + extension (1.4) = 3.7 kg ▪ Loosen cap on hydrant (using hydrant key + extension) – push down force 1.8 kg. Note: i) Height varies depending on orientation of teeth on cap; and ii) Forces depend on how tight last worker tightened the cap. ▪ Tighten independent gate valve on hydrant (using hydrant key + extension) – pull back force 2.7 kg. Note: Height varies depending on orientation of teeth. ▪ Open / close hydrant (using hydrant key + extension) at a height of 89 cm – horizontal push / pull force of less than 2.3 kg. ▪ Secure water hose to the independent gate valve (using hydrant key + extension) – horizontal force of 3.2 kg ▪ Loosen water hose (using hydrant key + extension) – horizontal pull force of 2.7 kg. ▪ Loosen independent gate valve (using hydrant key + extension) – horizontal pull force of 2.7 kg. Note: Height depends on orientation of teeth. <p>The lifts are within recommended weight limits for lifting tasks (WCB Worksheet B). Forces to loosen cap, tighten / loosen independent gate valve, open / close hydrant, and secure / loosen water hose are within ergonomic guidelines (Kodak, 1986, Mital et al., 1993).</p>

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
<p>4. Cleaning truck using water hose (Elgin Crosswind)</p>	<p>Awkward Posture:</p> <ul style="list-style-type: none"> ▪ Shoulder flexion 0-70° ▪ Elbow pronation ▪ Back flexion up to 45° ▪ Kneeling 	<p>30-45 min duration</p> <p>0-33% of shift (once per shift)</p>	<p>Dynamic (<30 sec.)</p> <ul style="list-style-type: none"> ▪ shoulder flexion, elbow pronation, back flexion, kneeling <p>Static (>30 sec.)</p> <ul style="list-style-type: none"> ▪ power grip hold on hose (with both hands) 	<p>Assessment</p>	<ul style="list-style-type: none"> ▪ While holding hose at elbow height, assumes shoulder flexion (up to 70°) + elbow pronation to maneuver hose ▪ Back flexion to wash off areas at bottom or underneath sweeper ▪ Kneeling to hose underneath sweeper – kneels on hose (to prevent contact stress on knees) <p>The dynamic nature and frequency and duration of the tasks do not exceed ergonomic guidelines for awkward postures (WCB Worksheet B). Able to pause and take mini-breaks as required.</p>
	<p>Force:</p> <ul style="list-style-type: none"> ▪ Wt. of hose 	<p>30-45 min duration</p> <p>0-33% of shift (once per shift)</p>	<ul style="list-style-type: none"> ▪ 2.5 kg wt of hose 		<ul style="list-style-type: none"> ▪ Support weight of hose – 2.5 kg (without water). Note: Forces while spraying (i.e. with water spraying) could not be measured since a horizontal force is applied forward to prevent the hose from going backwards. Horizontal force is dependant on water output pressure. <p>Force to support weight of hose is acceptable – worker has control over water output pressure and, consequently, the forces required to support the hose.</p>

SUMMARY

The risk identification and assessment for some of the Sweeper Operator's job tasks have identified some risk factors that exceed recommended guidelines. While these tasks have been assessed individually, cumulative effects of combined tasks may increase the level of risk.

In general the risk factors for the Sweeper Operator are related to exerting high forces (using back and shoulder muscles).

New crew members who have not acclimatized to the physical demands of work may be at an increased risk of injury. All crew members are at a higher risk of injury in the morning hours when they may not be physically prepared or warmed up prior to performing physically demanding work. This was demonstrated in the Corporation of Delta's musculoskeletal injury (MSI) analyses (2001) report where 55% of MSI WCB claims occurred in the AM.

Additionally, while not exceeding guidelines for the individual tasks, cumulative effects of awkward postures of the neck, back, shoulder and arm/wrist may increase the risk of injury (> 66% of shift when all activities or tasks are combined).

Recommendations for control of identified risk factors will focus on methods to minimize risk.

**Control Priority Note: 1 = recommended for implementation to reduce risk factors; 2 = optional, for consideration as a means of reducing risk factors; 3 = not for immediate action but for future consideration as appropriate.*

Risk Factor	Recommended Controls	Control Priority*	Responsible Person	Status
Endurance for physically demanding work	Maintain an increased level of fitness focusing on cardiovascular and muscular endurance and muscular flexibility. This is especially important for new workers who may not be acclimatized to the demands of work.	2	Employee	
Preparation for all physically demanding work	Workers should perform a warm up prior to the start of the day and before resuming work following >30 min. breaks. The duration of the warm up is less than 10 min. Micro stretches should also be performed following static, awkward postures e.g. neck and back bending.	2	Superintendent / Safety Dept.	
Force: Tools and equipment	Ensure all tools and equipment are in good shape and repair. Static forces will increase if tools and equipment require more work or repetition of work due to poor maintenance including cleaning. Evaluate tools and equipment when being replaced to ensure the weight and design (e.g. grip) will reduce the workload (e.g. wrenches, valve key etc.). Continue to encourage employees to use extension on hydrant key when filling water tank using a hydrant.	1	Superintendent Employee	
Operating parking brake (push) while seated on the RIGHT side	Pushing (releasing) the parking brake while seated on the RIGHT side exceeds ergonomic guidelines. It is, therefore, recommended that when pushing / releasing the parking brake, the operator should sit up or rise slightly from the seat so that the left elbow is completely extended while applying the push force. As a result, the operator will use much of their upper body strength to push the parking brake bringing the force application to acceptable limits (Humanscale, Tab 4: Human Strength, weak males).	3	Superintendent Employee	
		1	Superintendent Employee	
		1	Superintendent Employee	

Risk Factor	Recommended Controls	Control Priority*	Responsible Person	Status
Operating parking brake (push / pull) while seated on the LEFT side	Due to the postures assumed to push / pull the parking brake from the LEFT side, the forces exceed ergonomic guidelines. The sweepers do not have a "Park" setting in the gear shift and, therefore, the right foot must be on the LEFT side brake pedal while applying or releasing the parking brake. It is, therefore, recommended that the operators take the following steps to push / pull the parking brake: i) slide seat completely to the back; ii) tilt the steering column upwards; iii) raise the steering wheel to the highest point; iv) rotate control panel away from operator; v) shift buttocks to the right, i.e. on the centre console; and vi) with the shoulder to the side and elbow extended, sit up or rise slightly from the seat then apply (pull) or release (push) parking brake. With this set-up and procedure, it should be noted that the distance between the control panel and the back of the seat does accommodate large males (Grandjean, 1988 – 95 th percentile male's chest / abdominal depth). Refer to Figure 1 (page 14) for illustration of this control.	1	Superintendent Employee	
Lifting and lowering hood	Determine how high the hood must be raised for the pre-trip inspection. If required pre-trip inspections can be done while the hood is at a lower height, then the hood should only be raised until this height. Re-measure forces to lift and lower the hood to this height to determine if within guidelines. Investigate reducing the forces required to lift and lower the hood, i.e. mechanically.	1	Superintendent	
Overall risk factors	Provide education related to identified risk factors and methods of working to reduce risk e.g. neutral joint positions, leg position, reduction of twisting, avoiding contact stress etc.	1	Superintendent	



Figure 1: Releasing parking brake (push) while seated at the LEFT side: i) seat pushed to the back; ii) steering column tilted upwards; iii) steering wheel completely raised; iv) control panel pushed away from operator; v) shift buttocks to the right; and vi) arm on the side and elbow extended while pushing down on parking brake.

References:

- WCB of BC, Worksheet A, Risk Identification and Worksheet B, Risk Assessment.
- Eastman Kodak (1986), Ergonomic Design for People at Work, Volume 1
- Putz-Anderson (1988), Cumulative Trauma Disorders: A manual for musculoskeletal diseases of the upper limbs
- Mital, Nicholson & Ayoub (1993), A Guide to Manual Material Handling
- Humanscale (1981) – Tab 4: Human Strength
- Grandjean (1988) – Fitting the task to the Man

Prepared by: Farzana Ismail, April 25, 2003