



## JOB DEMANDS ANALYSIS

**Company:** City of Burnaby

**Location:** Paint Shop

**Job Title:** Signs & Markings Installer 1 & 2

**Classification:** Regular Duty

### Purpose of Activities

The Signs and Markings Installer 1 & 2 are responsible for installing and maintaining signs and assisting the Signs and Markings Installer 3/Tradesman painter with laying out and preparation for pavement marking and pavement re-alignments.

### Tools and Equipment

The Signs and Markings Installer 1 & 2 will use the following tools and equipment to perform his duties:

- Half-ton pick up truck with power tailgate (unadjustable seat on power tail gate)
- Bituminous tar applicators (hand push cart)
- Hand tools – wrenches, screw drivers, hammers, pliers, shovels, bars, drills, saws, sockets,
- Power tools – jack hammer 42-kg, (air and electric), concrete corer, cut off saw
- Traffic control – traffic cones, barricade signs
- Step and extension ladders

### Usual Methods

#### **Sign Installation/Sign Cleaning**

1. Receive work order from the Foreman.
2. Load signs and sign posts, tools and equipment into the half-ton truck.
3. Drive to work location.
4. Set up traffic control if required (signs, barricades).
5. Unload required tools, equipment from truck.
6. Dig hole for signpost sleeve if required. Use jackhammer, concrete corer, pick and/or shovel as required. Insert signpost sleeve into hole, plumb the signpost, sleeve, mix cement and pour the cement into the hole. Let this set overnight if required.
7. Attach sign post to the signpost sleeve with power tools and set screw.
8. Use a ladder to reach the top of the signpost. Clean the sign by hand or pressure washer. May use bucket truck.
9. Use power and hand tools to attach the sign to the signpost.
10. Clean up the work site and return tools, equipment and excess material to the half-ton truck.
11. Drive to next installation location.
12. Repeat steps for sign and sign post installation.



## **Pavement Marking**

### **Centre Line Truck**

Three Signs and Markings Installers 1 & 2's are required to assist the Signs and Markings Installer 3/Tradesman Painter's with Centre Line marking. One stands on the tail board of the Centre Line Truck and places traffic cones on the wet paint, one drive the half-ton truck while the third sits on the power tailgate of the half-ton truck and picks up traffic cones where the paint has dried. The crew will load five 200-litre paint drums on the Centre Line Truck with a forklift and then secure the drums to the truck with straps. Bags of glass bead (23-kg) are loaded to the truck and poured into the glass bead tank as required throughout the day.

### **Traffic Cone Placement (Centre Line Truck)**

1. Stand on the tailboard of the Centre Line Truck.
2. Drive to starting location for centre line painting.
3. Bend to grasp traffic cone from storage area on tailboard.
4. Bend to set traffic cones onto pavement from tailboard of Centre Line Truck.
5. Repeat steps 3 and 4.
6. Reload traffic cones from half-ton truck to storage area on tailboard of Centre Line Truck throughout the day.
7. Repeat steps 2 through 6 for the shift.

### **Half-ton Truck Driver**

1. Drive truck to starting point of centre line painting.
2. Follow ten to 15 minutes behind Centre Line Truck pavement marking route. This allows the centre line paint time to dry.
3. Meet Centre Line Truck at designated point to transfer traffic cones from half-ton truck to Centre Line Truck.
4. Repeat steps 1 through 3 for the rest of the shift.
5. Transfer 23-kg bags of glass bead from the half-ton truck to the Centre Line Truck as required.

### **Traffic Cone Pick-Up**

1. Drive half-ton truck to starting point for centre line painting.
2. Sit on unadjustable seat on power tailgate on the back of the half-ton truck. (less than 40 centimetres from the ground).
3. Laterally flex and rotate spine to the left. Flex shoulder and elbow to grasp traffic cone from the road.
4. Extend spine, rotate to the right, transfer the traffic cone to the left hand and stack on the power tailgate.
5. Repeat steps 2 through 4.
6. Meet Centre Line Truck at designated location to transfer traffic cones from the half-ton truck to the Centre Line Truck.
7. Repeat steps 1 through 6 for the remainder of the shift.
8. Transfer 23-kg bags of glass bead from the half-ton truck to the Centre Line Truck as required.



## Thermo-Plastic Crosswalk Installation

The Signs and Markings Installer 1 & 2's assist the Signs and Markings Installer 3/Tradesman Painter's with this task.

1. Signs and Marking Installers 1,2 and 3's will use a ball-peen hammer to break up the 23-kg blocks of thermo-plastic.
2. Place broken block of thermo-plastic into 20-litre pails (23-kg) for easy transport and access.
3. Repeat steps 1 and 2 until surplus thermo-plastic is available.
4. Start Thermo-Plastic Cooker four hours prior to use.
5. Load 20-litre pails of thermo-plastic onto Thermo-Plastic Truck. Open hopper to Thermo-Plastic Cooker and dump 20-litre pails into both sides of the hopper. Hoppers hold 63 to 136 kilograms of thermo-plastic. Let the thermo-plastic melt (220 degrees Celsius).
6. Load remaining 20-litre pails onto the truck deck for later use.
7. Drive to work site.
8. Set up traffic control to block crosswalk from pedestrian and vehicle traffic.
9. Unload Thermo-Plastic Applicator from trailer on half-ton truck.
10. Clean and prepare the crosswalk for the Thermo-Plastic Applicator. Respond to requests from the Signs and markings Installer 3/Tradesman Painter as required.
11. Drive to the next intersection or crosswalk.
12. Six to eight intersections with four crosswalks each can be completed per shift.

## Stimsonite Application (raised pavement markers/cat eyes) – two week per year

1. Light propane burner on tar pot. Load the tar pot with 4-kg blocks of solid tar. Let the tar melt (180 degrees Celsius).
2. Drive to location.
3. Unload tar pot from half-ton truck.
4. Two buffer vehicles (front and rear) are used to protect two crew members from on coming traffic.
5. One crew pushes the tar pot along the road and spreads molten tar dollops every 24 metres.
6. The second crew member walks behind carrying a 20-litre pail full of cat eyes. He will grasp a cat eye, bend/stoop and place the cat eye in the molten tar and then step on the cat eye to set it in the molten tar.
7. Repeat steps 5 and 6 (800 cat eyes can be placed in a day. The crew will rotate between the buffer vehicles, tar pot and placing the cat eyes.

## Stimsonite Removal

1. Two buffer vehicles (front and rear) are used to protect two crew members from on coming traffic.
2. One crew member will use a long handled chisel and 2-kg hammer to break the damaged cat eye from the tar.
3. The second crew member will come behind the first, pick up the broken pieces and place them in a 20-litre pail. The pail is emptied into the back of a buffer vehicle for disposal at a later time.
4. Repeat steps until damaged cat eyes have been removed.



**The presence of \*\* indicates non-value added tasks. These are tasks that do not contribute to the stated purpose of the work.**

### Administrative Issues

The Signs and Markings Installer 1 & 2 works from 0700 to 1530 Monday to Friday with a ten-minute rest period in the morning, a 30-minute lunch break and a ten-minute rest period in the afternoon. The Signs and Markings Installer 1 & 2 will work alternate shifts that accommodate traffic patterns and volumes. These alternate shifts may occur anytime throughout the day (day, evening or night). Overtime may also be required in this position either by extending the day or coming in on a scheduled day off. There are a combination of four full-time and four auxiliary Signs and Markings Installers 1's, 2's and 3's in this work area.

### Activity Demand Variables

These variables are tasks that must be carried out by the employee and are implicitly or explicitly required as objectives of the job.

- Sit to drive the half-ton truck and on the power tailgate to pick up traffic cones (unadjustable chair, spine is laterally flexed and rotated to the left, cervical spine is extended)
- Grasp traffic cones with left and right hands to place and pick up
- Work in low to high volume traffic during the day, evening or at night (exposed to catastrophic injuries in the event of a motor vehicle collision)
- Walk on road to mark pavement for marking
- Stand on road to mark pavement for marking
- Climb up and down 1.5 metre high deck on Centre Line and Thermo-Plastic Trucks
- Bend and stoop to set or pick up Stimsonite on pavement
- Climb a ladder for sign installation/cleaning
- Bend, stoop, crouch for sign installation/cleaning
- Use a jackhammer, concrete corer, power and hand tools for sign installation
- Fine finger manipulation tasks to make and install signs
- lift and carry 23-kg bags of glass beads, pails of Stimsonite to/from trucks and pallets in storage

### Worker Decision Variables

These variables are the sub-routines and cognitive/physical decisions made by the worker in carrying out the objectives of the job.

- Body positioning technique during some tasks
- Lifting and carrying techniques for some tasks
- Task organization

### Accommodative Considerations

1. People with injuries to the spine, in any region, may have difficulty with the static seated postures required when placing and picking up traffic cones; and the dynamic spinal movements required during pavement marking and sign maintenance and installation.



2. People with shoulder injuries such as rotator cuff tendonitis, bursitis and instability may have difficulty with static loading and reaching required during sign maintenance, installation and cleaning; Stimsonite application and removal and when placing and picking up traffic cones.
3. People with forearm and elbow injuries such as tennis elbow may have difficulty with the repeated static grip forces required during tool use for sign maintenance and installation.
4. People with nerve compression injuries in the upper extremities may have difficulty with the repeated and prolonged shoulder flexion activities required during hand and power tool use during sign maintenance and installation.
5. People with lower extremity injuries may have difficulty climbing in and out and on and off the Centre Line and Thermo-Plastic Trucks and any walking on pavement when performing road-marking tasks.
6. Post-whiplash and other neck problems may have difficulty with this position.
7. Individuals who do not cope in open low-autonomy work environments would have difficulty with this position.
8. Signs and Markings Installer 2 requires air-brake endorsement on a Class Five British Columbia Driver's License.

Prepared By: Jeffrey J. McGinn, Kinesiologist

June 8, 1999



## Summary of Stresses

### Metabolic Stresses

The aerobic energy systems will supply the major source of energy while performing the duties and responsibilities of the Signs and Markings Installer 1 & 2. This energy system will be required to maintain the low to moderate energy requirement necessary for road marking and sign maintenance and installation. Performing tasks and duties using poor posture or technique will decrease the metabolic demand required throughout the shift but these postures and techniques will increase the structural stress to the spine and upper and lower extremities. The layout and design of the existing seat on the power tailgate of the half-ton truck require the Signs and Markings Installer 1 & 2 to adopt high injury risk postures.

### Structural Stresses

**Spine** –Significant loading of the spinal structures are likely in this position. Prolonged loaded and unloaded forward flexion, lateral flexion and rotation of the spine to the left is required to place or pick up traffic cones when marking pavement. Sign maintenance and installation will require dynamic and static movements. These postures require no activity from the torso musculature, but increase asymmetrical disc compression and passive stretch on the posterior spinal ligaments and disc fibres. This can contribute to disc integrity problems as well as decondition the torso support musculature. Lateral flexion and/or rotation with or without forward flexion (loaded or unloaded) will significantly increase the shear forces encountered by the discs, fibres and spinal ligaments.

The seat on the half-ton truck and the power tailgate are not adjustable and may bottom out in certain instances. This will increase the risk of asymmetrical spinal compression on the discs, fibres and ligaments.

**Neck** –Significant and prolonged static and dynamic flexion, extension and rotation when driving the half-ton truck and placing and picking up traffic cones will increase the risk of injury to this structure. The upper trapezius and scalene muscles will be required to maintain a significant and constant load during the dynamic and static tasks of pavement marking and sign maintenance and installation.

**Shoulders and Upper Extremity**—road marking and sign maintenance and installation require prolonged and repeated static and dynamic movements from below to above shoulder height. The static and dynamic movements through the shoulder and upper extremity often require the rotator cuff muscle groups, upper trapezius and scalene muscles of the neck to maintain a constant and significant load. Performing pavement marking tasks and tool use for sign maintenance and installation will increase the static and dynamic loading of the forearm flexors, extensors, supinator, pronator teres and the pronator quadratus. The jackhammer, concrete corer and other power tools will also increase the vibration and compressive forces from the grip to the elbow and shoulder that may lead to over use tendon or nerve injuries. Impingement and inflammatory injuries to the shoulders are likely due to the prolonged static arm position (flexed and abducted shoulder and elbow) required during pavement marking and sign maintenance and installation. The above positions (cervical extension, thoracic kyphosis, anterior shoulder positioning) will weaken the shoulder girdle support structure and increase the risk of injury to this area.



Rotator cuff and biceps tendon tendonitis are likely as the muscle of the upper back and shoulder weaken through prolonged use.

**Hips and Lower Extremities** – Standing and walking on concrete and asphalt for the entire shift increase the compressive forces through the ankles, knee, hips and spine. Climbing up and down ladders and on and off the trucks will tax the knee, hip and ankle flexors and extensors. Prolonged sitting to drive the half-ton truck and on the seat on the power tailgate is likely to shorten the hamstring muscle group of both legs. This in turn will pull the pelvis under the body and prevent the Signs and Markings Installer 1 & 2 from sitting on the sit bones (Ischeal Tuberosity) and promote the undesirable forward flexed spinal posture.

**Motor Vehicle Accident** – The Signs and Markings Installer 1 & 2 is at significant risk for catastrophic injury on the tailboard of the Centre Line Truck and the power tailgate of the half-ton truck. Also, during road marking layout and Stimsonite (raised pavement markings, cat eyes) placement, the Signs and Markings Installer 1 & 2 walks in the middle of the road and is exposed to vehicle traffic. Traffic control is used but it is not always effective.

**Burn** – The Signs and Markings Installer 1 & 2 is exposed to molten tar (180 degrees Celsius) and crosswalk thermo-plastic (220 degrees Celsius) on a regular basis. Protective clothing and equipment are worn, but the risk of a burn is still present.

## **INTERVENTIONS**

Recommendations that could be implemented to increase productivity and lessen the risk of injury are listed below:

1. Teach postural awareness that will focus on the importance of proper body posture (seated and standing) and how it relates to the Sign and Markings Installer 1 & 2's ultimate physical comfort and fatigue level.
2. Encourage the Sign and Markings Installer 1 & 2 to maintain an increased level of fitness away from work that will focus on cardiovascular endurance, muscular strength, muscular endurance and flexibility. Particular attention should be paid to strengthen the shoulder complex and upper back.
3. Install fully adjustable air-ride seat on the power tailgate to prevent spinal compression and allow the Sign and Markings Installer 1 & 2 to adopt a neutral sitting posture.
4. Re-design the traffic cone placement and pick up tasks during centre line marking to eliminate the lateral flexion and rotation of the lumbar/thoracic spine and cervical extension and the exposure to vehicle traffic while sitting on the power tailgate or standing on the tailboard of the Centre Line Truck.

PJDC-Signs&Mark Installer 1&2

Referral: Lana Ho		Organization: City of Burnaby						Title: Signs & Markings Installer 1 & 2			
Dept.: Engineering		Division: Traffic						Contact: Greg Kenward			
PHYSICAL DEMANDS		R E Q U I R E D	S I D E	FREQUENCY*				Max. Weight (kg)	Usual Weight (kg)	COMMENTS	
				Sel 1	Low 2	Mod 3	High 4				
S T R E N G T H	Lifting - Floor to Knuckle	X	B			X		41	<1-6	tools, equipment, glass bead, tar, thermo-plastic	
	Lifting - Knuckle to Waist	X	B			X		41	<1-6	tools, equipment, glass bead, tar, thermo-plastic	
	Lifting - Waist to Shoulder	X	B			X		23	<1-6	tools, equipment, glass bead, tar, thermo-plastic	
	Lifting - Over Head	X	B			X		23	<1-6	tools, equipment, glass bead, tar, thermo-plastic	
	Carrying - With Handles	X	E			X		41	<1-6	jackhammer, 20-L pail, tools	
	Carrying - Without Handles	X	B				X	23	<1-6	tools, boxes of tar, thermo-plastic,	
	Pushing - Upper Extremity	X	B				X	23	<1-6	tools, equipment on/off trucks	
	Pushing - Hip/Leg Assist	X	B			X		41	<1-6	sign maintenance/installation	
	Pulling - Upper Extremity	X	B				X	23	<1-6	tools, equipment, on/off trucks	
	Pulling - Hip/Leg Assist	X	B			X		41	<1-6	glass bead bags, tools, equipment on trucks	
	Reach - Shoulder or Above	X	B			X		23	<1-6	lift tools, equipment to truck, sign posts	
	Reach - Sho. or Above extnd	X	B	X				23	<1-6	lift tools, equipment to truck, sign posts	
	Reach - Below Shoulder	X	B				X	41	<1-6	pavement marking, sign maintenance/installation	
	Reach - Bel. Shoulder extnd	X	B			X		41	<1-6	glass beads, 20-L pails, thermo-plastic, tar	
Handling	X	B				X	41	<1-6	tools, equip., signs, pavement marking material		
Gripping	X	B				X	40	<1-6	traffic cones, tools, equipment, material		
Fine Finger Movements							max.	low	sign maint./installation, pavement marking		
E N R G	Aerobic (percent)	X					95			pavement marking and sign maintenance and installation	
	Anaerobic (percent)			neg.						possible heavy lift, fatigue at end of day	
	High Energy Expenditure										
	Low Energy Expenditure	X					X			pavement marking and sign installation/maintenance	
P O S T U R E + M O B I L I T Y	Neck - Static Flexion	X					X			work below shoulders mark pavement, sign maint./installation	
	Neck - Static Neutral	X					X			walk, stand at work site, in shop, drive trucks	
	Neck - Static Extension	X					X			traffic cones pick up/placement, sign maint./installation	
	Neck - Rotation	X	L				X			drive trucks, sign installation, pavement marking	
	Throwing										
	Sitting	X					X			drive truck, sit to pick up traffic cones	
	Standing	X					X			pavement marking, sign making, sign maintenance and installation	
	Walking	X				X				pavement marking and sign maintenance and installation	
	Running/Jumping										
	Climbing - Arms and Legs	X			X						ladders, on/off trucks
	Climbing - Legs Only	X			X						ladders, hills on pavement stairs
	Bending/Stooping	X					X				pavement marking, sign maintenance and installation
	Crouching	X			X						sign installation and maintenance, pavement marking
	Kneeling	X		X							sign installation and maintenance
Crawling											
Twisting	X	E				X				pavement marking sign maintenance and installation	
Balancing	X				X					ladders, in seat on power tailgate to pick up traffic cones	
G E N E R A L	Traveling	X					X			pavement marking, signs maintenance and installation	
	Work Alone	X		X						when making signs in the shop	
	Interact with Public	X					X			drive in traffic, possible installing signs	
	Operate Equip/Machinery	X					X			half-ton truck, power tools	
Irregular/Extended Hours	X		X							0700-1530, Monday to Friday, OT day, evening, night shift	

\* Frequency Legend 1 = Seldom; Not Daily 2 = Low Daily Activity; < 1hr  
 3 = Moderate Demand; Repetition 1 - 3 hrs daily 4 = High Frequency Demand; Repetition > 3 hrs daily  
 The following shading denotes a HIGH RISK TASK:  Modifications should be considered

**REQD** is marked with an X if the particular demand or category is relevant to the purpose of the job.  
**SIDE** refers to the side or limb required to execute a task. If it is marked **E**, it indicates either side, the most common choice is listed first. **D** refers to dominant and **B** to both sides.

Referral:		Organization:						Title: see 1st page header	
Dept.:		Division:						Contact:	
PHYSICAL DEMANDS		REQD	SIDE	FREQUENCY*				COMMENTS	
				1	2	3	4		
P E R C E P T I O N	Hearing - Conversations	X					X	co-workers, supervisor, public	
	Hearing - Other Sounds	X					X	traffic, power tools and equipment	
	Vision - Far	X					X	pavement marking and sign maintenance and installation	
	Vision - Near								
W O R K E N V I R O N M E N T	Vision - Colour	X		X				pavement marking, make signs	
	Vision - Depth	X					X	pavement marking and sign maintenance and installation	
	Perception - Spatial	X					X	pavement marking and sign maintenance and installation	
	Perception - Form								
W O R K E N V I R O N M E N T	Feeling (Tactile)	X					X	hand/power tool use	
	Reading	X				X		work reports, work requests	
	Writing	X				X		work reports	
	Speech	X					X	with co-workers, supervisor, public	
	Inside Work	X		X				drive trucks, some shop work	
	Outside Work	X					X	pavement marking and sign installation	
	Hot Conditions >25 deg. C	X		X				possibly in spring, summer or fall	
	Cold Conditions <10 deg.C	X		X				possibly in fall, winter or spring	
	Humid	X		X				wet weather conditions	
	Dust	X		X				glass beads, dust at work site	
	Vapor Fumes	X				X		paint, tar, solvents	
	Hazardous Machines	X					X	Centre Line/Thermo-Plastic Trucks, applicators, power tools	
	Proximity to Moving Object	X					X	stand in traffic, ride on Centre Line Truck in traffic	
	Noise	X					X	trucks, traffic, power tools, applicators	
	Electrical Hazard	X		X				possibly overhead or underground services	
	Sharp Tools	X				X		shovels, utility knife, scrapers, jackhammer, concrete corer, saws	
Radiant/Thermal Energy	X		X				molten tar 180deg. C., thermo-plastic 220 deg. C., sun		
Slippery Conditions	X		X				wet pavement, grass, gravel mud installing signs		
Vibration and Related	X					X	hand, power tools, traffic cone pick up, removing cat eyes		
Chemical Irritants	X					X	thermo-plastic, bituminous tar, paints, solvents		
Organic Substances	X		X				dog feces, urine around signs posts		
Medical Waste									
Blood Products									
Congested Worksite	X					X	in traffic, pavement marking, sign installation		
Lighting - Direct	X					X	day light, sun light		
Lighting - Indirect	X					X	day light, sun light		
Lighting - Adjustable									
Lighting - Fluorescent	X				X		overhead lights in shop		
Lighting - Incandescent	X				X		possibly in shop		
Lighting - Shadows etc.	X		X				depends on time of day, weather and location of work		

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For detailed descriptions of each of the different categories, please refer to the reference guide or inquire with Human Effort at 1-888-4EFFORT