



JOB DEMANDS ANALYSIS

Company: Greater Vancouver Regional District **Location:** Victory Heights

Job Title: Water Mechanic **Classification:** Regular Duty

Purpose of Activities

The Water Mechanic is responsible for the regular maintenance and repair of the Greater Vancouver Regional District (GVRD) heavy mechanical equipment (marine boats, water pumps, diesel powered generators, diesel powered water pumps, etc.).

Tools and Equipment

The Water Mechanic will use the following tools and equipment to perform his duties:

- Dodge Cargo van
- Tools in van – wrenches, pipe wrenches, screw drivers, pliers, portable flood lights, hydraulic generator, cut-off saw, impact gun and tools, buckets, rope, fan, bars, manhole cover bar, machete, hammers, sledge hammers, utility knife
- Lake City Shop Tools – hand carts, furniture dolly, oxyacetylene torch on a cart, grinders, drill press, parts washer, sledge hammers, ropes, chains, wrenches, levels, clamps, pliers, cutters, pipe cutters, grease gun, bench vise, fire extinguishers, step and extension ladders, shop vac, portable welder, sand blaster
- Hard hat, steel toe boots, hearing protection, coveralls, face shield, safety harness, safety tripod to enter manholes and chambers, ropes, cell phone, two way radio
- Traffic controls – signs, traffic cones

Usual Methods

1. Receive paperwork on job from Supervisor
2. Drive to Lake City Shop to collect tools and equipment required for maintenance or repair.**
3. Drive to work site location.
4. Set up work site with tools and equipment. Generator and fan to pump clean air into chamber. Use gas detector to determine if chamber is safe to enter. Set up traffic



5. control if required. A second crew may perform traffic control duties if required. Set up tripod over chamber if required.
6. Enter chamber, pump house or building.
7. Prepare heavy equipment so that work can begin. In some cases this will include scraping and chipping tar off pipes, etc.**
8. Perform maintenance tasks or repair with hand and power tools. Where required heavy equipment is brought in to lift heavy equipment or parts.
9. Complete maintenance task or repair.
10. Clean up work site. Drive to next job or to the Lake City Shop or back to Victory Heights Yard.

Administrative Issues

The Water Mechanic works from Monday to Friday 0730 to 1600 with a ten-minute rest period in the morning, a 30-minute lunch break and a ten-minute rest period in the afternoon. There are four Water Mechanics and two Water Mechanic's Helpers. The Water Mechanic is assigned to a north or south section of the GVRD and may work alone for some tasks. Overtime is rare, but the Water Mechanic is required to be on-call for one weekend out of five, from Friday afternoon to Monday morning. Water Mechanic's are required to enter confined spaces that may or may not contain hazardous gases (H₂S, CO, etc.). The Water Mechanic estimates that he drives up to 100 kilometres per day to get to job sites in the GVRD.

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.

- Climb up and down a ladder to get in/out of a chamber (maximum 2.75 m deep)
- Raise and lower tools and equipment by hand or rope into chambers, vaults that can be up to 2.75 m deep
- Lift and carry tools, equipment, parts, materials from the van to the work area (2-10 m)
- Repair and maintain heavy equipment
- Kneel, crouch, bend and stoop to perform maintenance, repair or installation tasks
- Two ten-minute rest periods (one in the morning and one in the afternoon) and a 30-minute lunch break
- Work in all weather conditions including prolonged periods of rain or heat
- Enter confined spaces that may contain sewer gases
- Sit to drive van
- Stand in van, in chambers, vaults, grass, dirt, concrete



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.

- Lifting techniques to some extent
- Task organization

Accommodative Considerations

1. People with injuries to the spine, in any region, may have difficulty with the static and dynamic movements required during maintenance and repair of heavy equipment for the GVRD.
2. People with shoulder injuries such as rotator cuff tendonitis, bursitis and instability may have difficulty with dynamic and static loading and reaching activities required during maintenance and repair of heavy equipment.
3. People with forearm and elbow injuries such as tennis elbow may have difficulty with the repeated jarring and the static grip forces required during hand and power tool use during maintenance and repair tasks.
4. People with injuries to the lower extremities may have difficulty climbing in and out of the van; up and down ladders to the chambers, vaults; bending, stooping, crouching, and kneeling required to access heavy equipment for maintenance and repair tasks.
5. People who do not work well in a low-autonomy environment will have difficulty with this position.
6. People who are claustrophobic and do not like confined spaces may have difficulty with this position.
7. Must hold a valid Journeyman's ticket for Heavy Duty Mechanic.

Prepared By: Jeffrey J. McGinn, Kinesiologist

June 1, 1999



Summary of Stresses

Metabolic Stresses

The aerobic energy system will supply the major source of energy while performing the duties and responsibilities of the Water Mechanic. This energy system will be utilized during the maintenance and repair of GVRD heavy equipment. The anaerobic energy systems may be required to supply energy for brief intense periods of work, which may include heavy or sustained lifting or carrying; or towards the end of the day when the aerobic energy system has been depleted. In this last instance the anaerobic energy system becomes the primary energy source

Structural Stresses

Spine –Significant loading of the spinal structures are likely in this position. Prolonged loaded and unloaded forward flexion, extension, lateral flexion and rotation of the spine are all movements required by the Water Mechanic. Forward flexed 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 Water Mechanic will handle loads from less than one to 42 kilograms. Driving to and from each work location in a flexed spine position will also increase the risk for injury to the spine as described above.

Neck, Shoulders and Upper Extremity– the Water Mechanic will often perform prolonged and repeated static and dynamic movements. These static and dynamic movements through the shoulder and upper extremity require the rotator cuff muscle groups, upper trapezius and scalene muscles of the neck to maintain a significant load. Static loading of the forearm flexors, extensors, supinator, pronator teres and the pronator quadratus during tool use (shovel, hand and power tools, etc) will increase the risk of injury to these areas. Power and air tool use (drill, grinders, etc) will also increase the vibration, jarring and compressive forces from the grip to the elbow and shoulder that may lead to over use tendon or nerve injuries.

Almost all of the Water Mechanic's work is carried out in front of his body with some type of tool or implement. This position will weaken the shoulder girdle support structure and increase the risk of injury to this area. Rotator cuff and biceps tendon tendonitis injuries are likely as the muscle of the upper back and shoulder weaken through prolonged use. As this happens, thoracic spine kyphosis will increase and the cervical spine will be pulled forward out of its neutral position.



Hips and Lower Extremities – Standing and walking on concrete and asphalt will increase the compressive forces through the ankles, knee, hips and spine. The awkward positions required to access heavy equipment will not allow the Water Mechanic to perform the required work from a stable base of support. This in turn will increase the risk of injury for all of the other structures. Climbing in and out of the van and up and down ladders into and out of the chamber increase the risk of a slip and fall injury. Working in a wet environment will also increase the risk of injury due to slip and fall.

INTERVENTIONS

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

1. Encourage the Water Mechanic to maintain an increased level of fitness away from work that will focus on cardiovascular endurance, muscular strength, muscular endurance and flexibility.
2. Provide kneepads for the Water Mechanic for any work where kneeling is required, specifically on concrete, asphalt or other hard surfaces.
3. Provide regular education in effective use of the body and neutral joint positions for this type of work.

PJDC-Water Mechanic GVRD

Referral: Keith Arkell			Organization: GVRD						Title: Water Mechanic		
Dept.: Engineering			Division: Waterworks						Contact: Neil Walsh		
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				X		42	<1-8	tools, equipment, parts, materials	
	Lifting - Knuckle to Waist	X					X	42	<1-8	tools, equipment, parts, materials	
	Lifting - Waist to Shoulder	X				X		42	<1-8	tools, equipment, parts, materials	
	Lifting - Over Head	X			X			20	<1-8	tools, equipment, parts, materials	
	Carrying - With Handles	X			X			42	<1-8	tools, equipment, parts, materials	
	Carrying - Without Handles	X				X		42	<1-8	tools, equipment, parts, materials	
	Pushing - Upper Extremity	X					X	42	<1-8	tools, equipment, parts, materials	
	Pushing - Hip/Leg Assist	X				X		42	<1-8	tools, equipment, parts, materials	
	Pulling - Upper Extremity	X					X	42	<1-8	tools, equipment, parts, materials	
	Pulling - Hip/Leg Assist	X				X		42	<1-8	tools, equipment, parts, materials	
	Reach - Shoulder or Above	X			X			30	<1-8	tools, equipment, parts, materials	
	Reach - Sho. or Above extnd	X		X				20	<1-8	tools, equipment, parts, materials	
	Reach - Below Shoulder	X					X	42	<1-8	tools, equipment, parts, materials	
	Reach - Bel. Shoulder extnd	X			X			42	<1-8	tools, equipment, parts, materials	
	Handling	X					X	42	<1-8	tools, equipment, parts, materials	
Gripping	X					X	50	<1-8	tools, equipment, parts, materials		
Fine Finger Movements	X					X	max.	low	handle, fit parts, equipment, nuts, bolts, etc.		
E	Aerobic (percent)	X					95	repair and maintain mechanical equipment			
N	Anaerobic (percent)	X		neg.				heavy lift, hold part for repair or to fasten part			
R	High Energy Expenditure										
G	Low Energy Expenditure	X					X	repair and maintain mechanical equipment			
P O S T U R E + M O B I L I T Y	Neck - Static Flexion	X					X	work below shoulders to repair and maintain mechanical equipment			
	Neck - Static Neutral	X					X	stand, walk, sit, work at shoulder level			
	Neck - Static Extension	X				X		work above shoulders from bend/stoop/crouch/kneel/crawl			
	Neck - Rotation	X	E				X	drive van, access mechanical equipment			
	Throwing										
	Sitting	X			X			in van to drive to work location, shop			
	Standing	X					X	at work site, in chamber, in water, on concrete, dirt, asphalt			
	Walking	X					X	betwe van and work site, chamber, less than 50 metres			
	Running/Jumping										
	Climbing - Arms and Legs	X		X				ladders, wall ladders			
	Climbing - Legs Only	X			X			stairs, hills to work site			
	Bending/Stooping	X					X	to repair and maintain mechanical equipment			
	Crouching	X				X		to repair and maintain mechanical equipment			
	Kneeling	X			X			to repair and maintain mechanical equipment			
	Crawling	X		X				to access mechanical equipment			
Twisting	X	E			X		to repair and maintain mechanical equipment				
Y	Balancing	X			X			on ladders, pumps, motors, stairs			
G E N I R	Traveling	X				X		in GVRD to work sites			
	Work Alone	X		X				on occasion but will usually have Mechanic's Helper			
	Interact with Public	X			X			drive in traffic			
	Operate Equip/Machinery	X				X		van, power tools, generators, motors, pumps			
	Irregular/Extended Hours	X		X				0730-1600, Monday to Friday, OT rare, on-call 1 weekend in 5			
* 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.

PJDC-Water Mechanic GVRD

Referral:		Organization:						Title: see 1st page header	
Dept.:		Division:						Contact:	
PHYSICAL DEMANDS		R E Q D	S I D E	FREQUENCY*				COMMENTS	
				Sel. 1	Low 2	Mod. 3	High 4		
P E R C E P T I O N	Hearing - Conversations	X				X		other Water Mechanics, Mechanic's Helpers, Supervisor, Tradesman	
	Hearing - Other Sounds	X						tools, pumps, motors, generators	
	Vision - Far	X					X	repair and maintain mechanical equipment	
	Vision - Near								
	Vision - Colour	X		X				oil, fluids	
	Vision - Depth	X					X	body position to repair & maintain mechanical equipment	
	Perception - Spatial	X					X	body position to repair & maintain mechanical equipment	
	Perception - Form	X		X				oil, fluids	
	Feeling (Tactile)	X				X		tool use, move parts into position	
	Reading	X				X		work order reports	
W O R K E N V I R O N M E N T	Writing	X				X		work orders, reports	
	Speech	X				X		other Water Mechanics, Mechanic's Helpers, Supervisor, Tradesman	
	Inside Work	X				X		in van, chambers, buildings	
	Outside Work	X					X	at work sites	
	Hot Conditions >25 deg. C	X		X				spring, summer, fall	
	Cold Conditions <10 deg. C	X		X				fall, winter, spring	
	Humid	X		X				in chambers, wet weather conditions	
	Dust	X		X				possibly at work site, cleaning debris from mechanical equipment	
	Vapor Fumes	X		X				enter chamber, H2S, CO	
	Hazardous Machines	X					X	van, power tools, diesel powered water pumps, equipment, boats	
	Proximity to Moving Object	X				X		traffic in van, moving parts in motors	
	Noise	X				X		running pumps, motors, generators, in/out of chambers	
	Electrical Hazard								
	Sharp Tools	X				X		utility knife, scrapers, chisels, machete, drill, grinder	
	Radiant/Thermal Energy	X		X				hot motors, fluids, sun	
	Slippery Conditions	X		X				water in chambers, wet weather, mud, snow, ice	
	Vibration and Related	X				X		hand and power tools	
	Chemical Irritants	X		X				H2S, CO	
	Organic Substances	X		X				decaying plant matter, vegetation, stagnant water in chamber	
	Medical Waste								
	Blood Products								
	Congested Worksite	X		X				in chambers, around motors, pumps, boats, etc	
	Lighting - Direct	X					X	day light, sun light, trouble lights, lights in buildings	
	Lighting - Indirect	X					X	day light, sun light, trouble lights, lights in buildings	
	Lighting - Adjustable	X			X			trouble lights in chamber, or at work site	
	Lighting - Fluorescent	X			X			in buildings	
	Lighting - Incandescent	X			X			in buildings	
	Lighting - Shadows etc.	X			X			depends on time of day and location of works	

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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