



JOB DEMANDS ANALYSIS

Company: Greater Vancouver Regional District **Location:** All Plants

Job Title: Sewer – Wastewater Mechanic **Classification:** Regular Duty

Work Demand Level: Medium to Very Heavy

Purpose of Activities

The purpose of the duties of the Sewer Plant Mechanic is to carry out repairs and maintenance of equipment in the wastewater plant (Annacis Island, Lulu Island, Iona and Lion's Gate).

Tools and Equipment

The mechanic will use the following tools and equipment to perform their duties:

- Gloves.
- Safety Hat
- Safety Boots.
- Safety Vest.
- Electric cart.
- Variety of hand and power tools including impact tools and large crescent wrenches.
- Come-along
- Hammers (ballpeen)
- 2" Fire Hose
- Overhead crane/hoist
- Parts Washer
- Flashlight
- Lathe

Usual Methods

The job varies substantially from day to day as they may be involved in smaller routine maintenance tasks or the installation or removal of pumps or engines. Essentially they are either doing work in the field or in the shop. They may spend large blocks of time in the repair shop disassembling, repairing and rebuilding a variety of mechanical pieces. They would spend no more than 30 minutes a day engaged in seated paperwork related duties such as estimating part requirements. They can be seated for brief periods of time when working at benches. They are working with a variety of tools throughout the day ranging up to a 48" pipe wrench. Many of the larger

tools are made from aluminum which significantly reduces their weight and improves their ease of handling considerably.

In the field, they may have to use large, heavily leveraged tools such as a pipe wrench in very awkward positions. These positions can include extended kneeling or crouching in addition to reaching and considerable spinal flexion. Almost all of the pumps and engines are positioned at knee level from the floor. In order to work on these, the workers' are required to kneel or crouch for long periods of time. Even in the shop, it can be awkward to work on large objects.

The other area they can work is on the engines used in Cogeneration. This involves working in a forward flexed posture and on ladders.

The plant they are working in can also dictate some of the demands of the work. Annacis (in particular) and Lulu are more spacious and feature more hoists and cranes. The newer pumps and motors are also set on higher footings so that it is not necessary to work as close to floor level. The older plants tend to be more congested and the equipment is often set lower to the ground. It is more likely that block and tackle will have to be used instead of using hoists and forklifts.

Administrative Issues

Typically they work an eight - hour day from Monday to Friday (0600 – 1530 with 30 minute lunch and two breaks). Most of the work is conducted indoors (outdoors is possible but less likely) and can include exposure to raw sewage and the risk of dangerous gases (such as H₂S). They have assistance of labourers for some heavy tasks.

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.

- Work in some confined spaces.
- Walk over concrete and stairs.
- Climb up and down ladders.
- Carry out some tasks under unpredictable outdoor conditions that often include steady rainfall.
- Exposure to sewage.
- Awkward equipment located close to the floor or overhead (equipment dictates posture).
- Duties typically assigned daily



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.

- Choose postures for carrying out duties (e.g. lifting using hips and maintaining neutral spine, creative energy saving techniques).
- Planning of lifts and routes for carrying (limited).
- Limited planning of approach to repair job.
- Limited flexibility of break selection.
- Mode of transportation around site.

Accommodative Considerations

1. Individual with spine related problems may have difficulty with the crouched and stooped postures as well as with lifting activities.
2. Upper extremity problems including the hand, wrist and elbow would be difficult to accommodate because of constant gripping and tool manipulation with force (especially in awkward postures).
3. Shoulder injuries may also be aggravated by the heavy tool use and elevated arm postures inherent in the job.
4. Individuals recovering from systemic illness should be carefully screened before entering this activity.
5. Individuals who do not cope well in outdoor work environments or confined spaces would have difficulty with this position.
6. There is a long learning curve associated with the tasks that includes formal training.

Prepared By: Greg Hart, Kinesiologist

June 1, 2001



Summary of Stresses

Metabolic Stresses

These stresses can be highly variable with the majority of power being supplied through the aerobic energy system in reasonably fit individuals. Duties such as walking, sitting, crouching and kneeling would predominantly draw energy from this system. More concentrated activity like stair climbing (which can be common) will challenge the aerobic system more. Many activities require high levels of force production from a variety of muscle groups to pull on wrenches, to lift and move parts or to climb ladders. The power for these requirements would be primarily derived from the anaerobic metabolism and can be drawn upon frequently through the day for brief (usually less than 45 seconds) periods of time. The maximum energy demand is in the order of 6 METs (21 ml/kg/min).

Structural Stresses

There are a number of high risk exposures to the physical structures of the body in this job. Some are related to movement and some are related to postures.

Spine

There is obvious exposure to most of the spine, but more specifically to the lumbar and thoracic regions. This exposure can come from several different possibilities. The first is high anterior disc compression from flexed postures that can include supporting high loads great distances from the body in awkward locations. The second possibility is that of prolonged strain on the spinal ligaments from working in a kneeling position. This increases instability of the structures over time. A third possibility is a sudden shearing force when lifting or moving a heavy object or when a wrench pops off of a bolt. The last aspect is rotating motions which can occur in combination with the previous factors. This exposes the facet joints of the spine to damage as well as weakening the disc fibre integrity. If proper lifting technique is observed when lifting is required in comfortable spaces, the risk to the spine will be minimal even if the loads are high. There is severe postural stress in carrying the toolbox which can weigh up to 35 kilograms. Since it is a one arm carry, the opposite side of the body is forced to compensate for the uneven loading, placing severe lateral compression on the spine and possibly interfering with normal neuromuscular spinal control if it occurs frequently enough.

Shoulder and Upper Extremity

The shoulder joint has to contend with sustained flexed and abducted postures under occasionally high load. The result is considerable joint instability with high joint



compression and ligament strain in addition to probable temporary supraspinatus impingement from time to time.

The muscles of the forearm and wrist are required to produce frequent and often constant moderate to maximal grip forces. This combined with the often pronated or deviated position of the joint can lead to carpal tunnel stress and tendinitis even previous to that. The elbows would be at particularly high risk of developing epicondylitis from the constant mechanical strain on the muscles and tendons that originate there.

Knee and Ankle

The knee absorbs considerable compressive stress in kneeling and crouching postures. Kneeling can place high loads against the patella (kneecap) when it is unsupported and the knee joint is 'open'. Crouching loads the ligaments in the joint past the critical stress limits of the connective tissue and can contribute to increased joint laxity over time. Anterior knee pain and the development of patello-femoral syndrome are likely in these individuals. Arthritic changes can also be expected in most workers.

The ankle joint is required to stabilize the body in balanced positions on ladders and pipes and in all joint directions. It is particularly vulnerable on the lateral aspect to sudden inversion of the foot on uneven surfaces.

INTERVENTIONS

1. Recommendations that could be implemented to increase productivity and lessen the risk of injury are listed below:
2. Every effort should be made to provide tools that are light and easy to use because of the awkward positions frequently encountered in the job. In addition care should be taken to improve grip sizes to as close to individual optimal sizes to maximize force transfer and reduce forearm flexor strain.
3. Mechanical assists should be utilized wherever possible to reduce dangerous loading in awkward spaces. Continued education in rigging techniques is vital.
4. Educate employees relative to creative movement technique to help limit exposures to unmanageable physiological stress.
5. Splitting tools across two boxes would balance the load on the spine substantially when carrying the toolbox(es). One in each hand.



6. Providing a small dolly will be helpful in transporting tools over large distances.
7. Provide gloves that offer the required protection with minimal interference in sensation.
8. Adjustable lift tables should be supplied in the Repair Shop so that the equipment is always being worked on at the appropriate level. This would remove a considerable amount of kneeling and forward spinal flexion from the job. It would also improve force transfers to the tools from the body, decreasing the strain on the workers' elbows.
9. Knee pads should be provided to all workers to reduce heating and compression of the knee joint.
10. Active whole body conditioning would be the best protection against injury as the nature of the job places many unmanageable stresses on many structures. Ensuring that the tissue is strong and flexible and that energy delivery is efficient would be a critical recommendation.
11. The final recommendation involves moving from the sedentary activities of sitting or standing to a labour intensive task. Time should be taken to put the muscles and joints of the torso, hip and shoulder region through a full range of motion and to increase muscle and joint temperatures. This insures adequate preparation of body structures to effectively and safely participate in the required activities.

PJDC-WWTP Mechanic

Referral: Mike Arcand		Organization: GVRD						Title: WWTP Mechanic	
Dept.: WWTP		Division: WWTP						Contact: Mike Arcand	
		Date: June 1, 2001							
PHYSICAL DEMANDS	REQD	SIDE	FREQUENCY*				Max. Weight (kg)	Usual Weight (kg)	COMMENTS
			Sel 1	Low 2	Mod 3	High 4			
S T R E N G T H					X		75	20	Tool kit, fittings, pumps, motors, pipe
					X		75	10	Motors, toolkit, pipe, come-along
					X		35	5	Fittings, rigging equipment and tools
					X		20	arm+	Fittings, rigging equipment and tools
					X		30	30	Toolbox (one arm) < 10 metres
					X		35	5	Parts < 10 metres
						X	55	20	Wrenches and tools, chains on rigging
					X		100	40	Wrenches, motors (some suspended)
						X	55	20	Wrenches, parts, comealong
					X		100	40	Chain on come-along or on wrenches
				X			arm +	arm +	Overhead repairs and installations
				X			arm +	arm+	Sustained in awkward locations
						X	35	arm+	Accessing tools, around fittings etc.
					X		35	low	Reaching around large equipment
E N R G Y						X	max.	mod	Tools, parts, pipe, hoses. .
						X	max.	high	Tools (especially wrenches), parts
					X		high	low	Small bolts/nuts, cleaning +adjustment
						70			Walking, light climbing, standing, low level tool work
					30				Full body exertion in lifting, pull/pushing, climbing
					X				Occasional full body activity
				X					Walking, desk/bench work, travelling
						X			Most repair tasks (sustained up to 10 min/time)
						X			While walking, standing
				X					Can be prolonged when working overhead
						X			Normal movement and see around objects
				X					Chains or cables over pipes for rigging (< 5 m)
				X					Infrequent, when in travelling, on break or desk work
						X			Almost always and on concrete surfaces
						X			Almost always over concrete, grass, metal pipes
P O S T U R E S				X					Over obstructions, on/off ladders (< 1m)
				X					Ladders and scaffolding
					X				Stairs (up to six flights) and step up onto raised areas
					X				Working on many tasks in shop and plant
					X				Most tasks are close to ground level
				X					Tasks at ground level, prolonged at times
			X						Into and out of confined spaces, access awkward fittings
				X					Working around some awkward equip., in/out con. space
				X					On ladders and pipes
				X					Around plant in cart, truck, bike, occ. Offsite in half ton
					X				Dependent on job , it is possible - radio contact
			X						Rare except on tours or driving off-site
					X				Valves, motors, welding equip., rigging, SCBA
			X						In emergencies

* 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		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		B				X	Communicating with co-workers
	Hearing - Other Sounds		B				X	Pumps, motors, alarms etc
	Vision - Far						X	Most tasks
	Vision - Near					X		Small, detailed adjustments
	Vision - Colour					X		Pipes, motor wiring are colour coded
	Vision - Depth					X		Judging distance, often in poorly lit areas
	Perception - Spatial					X		Need to understand relative object position
	Perception - Form					X		Differentiate between fittings and tools with small differences
	Feeling (Tactile)					X		Grip adjustment through gloves
	Reading				X			Work orders, signs
N	Writing				X			Minor notations and reporting
	Speech					X		Communicating with co-workers
	Inside Work					X		Buildings, tunnels, occ. digester, underground
W O R K	Outside Work				X			Moving between buildings, outside repairs, lift stations
	Hot Conditions >25 deg. C					X		Depending on the part of the plant, varies
	Cold Conditions <10 deg.C			X				Outside work during winter
	Humid			X				Occasionally
	Dust				X			Plant is very clean, just in some confined areas
	Vapor Fumes					X		Exhaust, sewage (H2S,Meth.)
	Hazardous Machines					X		Pumps, motors, crane, fans, mechanical skimmers etc.
	Proximity to Moving Object				X			Forklift, floor scrubber, overhead crane, trucks, bikes
	Noise						X	Varies to above 110Db (protection req'd)
	Electrical Hazard				X			Working with motors
E N V I R O N M E N T	Sharp Tools				X			Cutting tools, exposed metal and fragments
	Radiant/Thermal Energy						X	Motors, pipes, pumps, welding equip.
	Slippery Conditions					X		Working in wet areas, near leaks etc.
	Vibration and Related				X			Hose, hammer
	Chemical Irritants					X		Cleaners
	Organic Substances						X	Raw or partially processed sewage
	Medical Waste			X				Possible at headworks
	Blood Products			X				Unlikely, although technically possible
	Congested Worksite					X		Many confined areas - training req'd
	Lighting - Direct						X	Overhead incandescent, daylight
T	Lighting - Indirect						X	Reflected light
	Lighting - Adjustable				X			Portable lighting
	Lighting - Fluorescent					X		Some fixtures in different work areas
	Lighting - Incandescent						X	Overhead
	Lighting - Shadows etc.						X	Everywhere due to obstructions

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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