



JOB DEMANDS ANALYSIS

Company: Greater Vancouver Regional District **Location:** Annacis Island

Job Title: Instrument Technician **Classification:** Regular Duty

Work Demand Level: Medium

Purpose of Activities

The purpose of the duties of the Instrument Tech is to maintain all of the controls and sensors used in the wastewater plant (s) (Annacis Island, Lulu Island, Iona, Langley and Lion's Gate).

Tools and Equipment

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

- Gloves.
- Safety Hat
- Safety Boots.
- Safety Vest.
- Pneumatic chair with foot ring.
- Electric cart.
- Instrument Air Bottle
- Variety of hand tools including pliers and screwdrivers.
- Flashlight
- Testing equipment (e.g., volt tester).

Usual Methods

There are two basic components to the Instrument Technician's job. The first involves activities in the field and the second involves activities in the shop.

The shop work is mainly comprised of carrying out fine construction and deconstruction work. Many of the components feature small valves and a considerable amount of microelectronics. The Techs use a variety of small tools and also use testing jigs. They may be required to bend small instrument air pipe. Since the work is small most of it is carried out on benches while standing or sitting on high



chairs with foot-rings. Typically the postures involve forward flexion of the trunk and head combined with static holding through the shoulders and neck to position the arms for the precise nature of the work.

In the field, some servicing of controls or sensors is carried out, but more often, field work involves the removal or installation of the components. There are a number of awkward access issues involved in field work that can require postures ranging from crouching to extended reaching and overhead work. It can involve the use of heavier tools like a Hilti drill, but that is more of an exception. Most of the field applications are accessed via a motorized cart combined with some walking and stair-climbing.

There is some paperwork, specifically rewriting diagrams, examining diagrams or reading manuals. This can be done either from sitting or standing and most of it is done in the shop.

Usual Methods – Plant Specific Issues

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. Older plants may also have more frequent failures.

Administrative Issues

Typically they work an eight - hour day from Monday to Friday (0600 – 1530 with 30 minute lunch and two breaks). Three Instrument Techs are working at any time with five total in the group (the other two take care of other plants). They rotate weekend standby coverage. 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 potential assistance of helpers for some heavy tasks if necessary. They may have to travel between plants.

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.



- 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 (techs have dedicated covered cart for transport at Annacis plant).

Accommodative Considerations

1. Individual with spine related problems may have difficulty with the forward flexed postures associated with the bench work and some access issues in the field. There is also the potential for occasional prolonged sitting.
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 and neck injuries may also be aggravated by tool use and elevated arm postures inherent in the job.
4. Individuals recovering from systemic illness or pacemakers should be carefully screened before entering this activity (working alone).
5. Individuals who do not cope well in confined spaces or working alone 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 are generally mild. Most of the activities are brief walking and stair-climbing or prolonged sedentary postures like sitting, standing and crouching. Only occasionally are demands any higher. The maximum energy demand is in the order of 5 METs (17.5 ml/kg/min) and the typical demand is closer to 2 METS (7 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

The lumbar and thoracic spine is regularly involved in forward flexed activity. This can lead to anterior disc compression, weakening of the posterior disc fibre integrity and increased laxity in some spinal ligaments. A shortening of anterior torso muscles (i.e., chest and shoulders) can accompany a weakening of the posterior upper back musculature. Prolonged standing on concrete can also contribute back discomfort as the ground reaction forces are transferred up through the skeleton. Sitting on the high chairs with no weight bearing foot support increases the loading of the spine by preventing weight to be transferred through the legs to the ground.

Shoulder and Upper Extremity

The shoulder joint has to contend with sustained flexed and abducted postures when working on precise activities. There is also the potential for sustained shoulder elevation when working over the bench which can lead to chronic increases in neck muscle tension, especially when combined with the head forward postures common in this work. High levels of precision can generate higher levels of muscle tension as the body seeks to limit any extraneous movement.

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. There is a lot of pinch grip activity using small tools and fitting wires into receptacles and components resulting in high loading over the tendons supplying the thumb and first two fingers.



Feet and Knees

Prolonged standing on concrete insures a steady reflection of forces through the feet and knees.

INTERVENTIONS

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

1. Educate employees relative to creative movement technique to help limit exposures to unmanageable physiological stress.
2. Instrument Technicians should receive formal training in ergonomic design principles since they are involved in developing and servicing components that many other people rely upon and interact with.
3. Knee pads should be provided to all workers to reduce heating and compression of the knee joint.
4. 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.
5. 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 Instrument Technician

Referral: Mike Arcand		Organization: GVRD						Title: WWTP Instrument Tech		
Dept.: WWTP		Division: WWTP						Contact: Mike Arcand		
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	Lifting - Floor to Knuckle		B		X			15	<5	Some sensors, tools, pressurized air bottle
	Lifting - Knuckle to Waist		B			X		15	5	Toolbelt, small instruments, parts, impact tool
	Lifting - Waist to Shoulder		B			X		15	5	Small instruments, parts, impact tools, hand tool
	Lifting - Over Head		D	X				10	arm+	Sensors/controls, tools into awkward installs
	Carrying - With Handles									
	Carrying - Without Handles		D		X			15	<5	Small parts, controls/sensors, tools <100 m
	Pushing - Upper Extremity		B		X			10	<5	Connecting sensors or controls, doors
	Pushing - Hip/Leg Assist		B		X			15	5	Wrenches/tools in occasional difficult situation
	Pulling - Upper Extremity		B			X		15	5	Wrenches, bending small instrument pipe
	Pulling - Hip/Leg Assist		B		X			20	<5	Wrench, removing heavy component
	Reach - Shoulder or Above		D		X			arm +	arm +	Overhead repairs and installations
	Reach - Sho. or Above extnd		D	X				10	arm+	To access awkward instrument overhead
	Reach - Below Shoulder		B		X			10	arm+	To access awkward instrument, access part/tool
	Reach - Bel. Shoulder extnd		B	X				10	arm+	To access awkward instrument, access part/tool
Handling		B				X	max.	mod	Tools, parts, small pipe, instruments	
Gripping		B				X	max.	mod.	Tools (often small), parts, pinch grip is prevalent	
Fine Finger Movements		B				X	high	low	Fine electronics, wires, cables and tools	
E N R G	Aerobic (percent)						90			Walking, light climbing, standing, sitting, low level tool work
	Anaerobic (percent)			10						Full body exertion in lifting, pull/pushing, climbing
	High Energy Expenditure			X						Occasional full body activity
	Low Energy Expenditure						X			Walking, desk/bench work, travelling
P O S T U R E + M O B I L I T Y	Neck - Static Flexion						X			Many repair tasks (sustained several minutes/time)
	Neck - Static Neutral						X			While walking, standing
	Neck - Static Extension				X					Can be prolonged when working overhead
	Neck - Rotation		B				X			Normal movement and see around objects
	Throwing									
	Sitting					X				For some bench work and when driving in cart (< 5 min/time)
	Standing						X			Almost always and on concrete surfaces (some metal surfaces)
	Walking						X			Almost always over concrete, asphalt, metal, grass
	Running/Jumping			X						Over obstructions, on/off ladders (< 1m)
	Climbing - Arms and Legs				X					Ladders and scaffolding
G E N	Climbing - Legs Only					X				Stairs (up to six flights) and step up onto raised areas
	Bending/Stooping				X					Work on some sensors/controls in the plant(sustained at times)
	Crouching				X					Some controls are close to ground level
	Kneeling				X					Tasks at ground level (on concrete or metal), prolonged at times
	Crawling			X						Into and out of confined spaces
	Twisting				X					Working around some awkward equip., in/out confined space
	Balancing				X					On ladders, top of buildings (sometimes sloping)
	Traveling				X					Around plant in cart, truck, bike, occ., offsite in half ton
	Work Alone					X				Out of shop it is probable - always radio contact
	Interact with Public			X						Rare except on tours or driving off-site
N	Operate Equip/Machinery						X			Controls, sensors, computers, testing apparatus
	Irregular/Extended Hours			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.

PJDC-WWTP Instrument Technician

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		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, component wiring are colour coded	
	Vision - Depth						X	Judging distance, often in poorly lit areas	
	Perception - Spatial						X	Need to understand relative object positions	
	Perception - Form					X		Differentiate between wiring with small differences	
	Feeling (Tactile)		B				X	Grip adjustment (through gloves at time)	
	Reading						X	Manuals, diagrams, work orders, signs, email	
	Writing				X			Minor notations and reporting	
	Speech						X	Communicating with co-workers	
	W O R K E N V I R O N M E N T	Inside Work						X	Shop, buildings, tunnels, underground
Outside Work						X		Moving between buildings, outside repairs	
Hot Conditions >25 deg. C						X		Depending on the part of the plant, varies, warm summer days	
Cold Conditions <10 deg.C				X				Outside work during winter	
Humid				X				Occasionally outside and in some parts of plant	
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, carts, trucks, bikes	
Noise							X	Varies to above 110Db (protection required)	
Electrical Hazard					X			All controls should be locked out prior to working	
Sharp Tools					X			Cutting tools, exposed metal, wire and fragments	
Radiant/Thermal Energy							X	Motors, pipes, pumps, welding equip.	
P S Y C	Slippery Conditions					X		Working in wet areas, near leaks etc.	
	Vibration and Related				X			Hose, hammer and riding in carts (more jarring)	
	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/fluorescent, daylight	
	Lighting - Indirect						X	Reflected light	
	Consequences of Error						X	High, failure of control/sensor lead to failure (operational/injury)	
	Competence Challenge				X			Always new equipment and processes to learn, time challenge	
	Autonomy						X	Decisions about specifics of the job not about which job to do	
	Relatedness				X			Limited team work required, have to get along with co-workers	

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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