



JOB DEMANDS ANALYSIS

Company: City of Burnaby

Location: Automotive Shop

Job Title: Tradesman – Mechanic –
Heavy Equipment

Classification: Regular Duty

Purpose of Activities

The Heavy Equipment Mechanic is responsible for the repair and maintenance of the heavy vehicle and equipment fleet owned the City of Burnaby. The heavy vehicles and equipment are comprised of Garbage Trucks, Recycle Trucks, Five-Ton Trucks with a dump box, One-Ton Truck with a dump box, Bread vans, Street Sweeper, Flusher Truck, Grader, Backhoe, Front End Loader, etc.

Tools and Equipment

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

- Automotive shop bay (seven bays) with vehicle hoist (heavy vehicles and equipment), four outside bays under an open canopy
- Hand tools (wrenches, screw drivers, sockets, chisels, punches, hammers, task light, cheaters, hammers, sledge hammer, etc.)
- Air tools (1/2 and 3/4 inch impact gun, pistol and in-line grip)
- Recycled oil/fluid drum with extension, funnels
- Parts washer, solvent
- Work bench with vise, step ladder, extension ladder
- Forklift, cherry picker lift, floor jack, jack stand
- Parts room

Usual Methods

1. Receive work order for vehicle.
2. Locate vehicle/equipment. The Heavy Equipment Mechanic will search for the vehicles/equipment in the five acre Works Yard. **
3. Drive the vehicle/equipment into the shop bay. Some vehicles/equipment are too large for the shop bay and will be repaired under the awning outside the shop.
4. Get out of the vehicle/equipment. Determine how to work on the vehicle/equipment based on the work order. Does the vehicle/equipment need to be raised on the hoist, can it be raised on then hoist, can it be jacked off the floor with floor jacks or worked on parked on the shop floor. Bend, stoop, crouch or crawl under the vehicle/equipment to set the hoist supports, floor jacks and/or jack stands in the proper location under the vehicle/equipment. Some vehicles (Garbage, Recycle trucks) have cabs that tip



forward by pumping a hand lever at shoulder height. The Heavy Equipment Mechanic uses a ladder to access the engine.

5. Raise the vehicle/equipment off the floor by raising the hoist or hand pumping the floor jack.
6. Gather tools and equipment to perform the required repair.**
7. Dismantle the vehicle/equipment parts and components allowing for access to the defective part. The Heavy Equipment Mechanic will use hand, power and air tools to dismantle the parts. Parts size and weight will range from light to extremely heavy. Some parts can be handled easily by hand while other parts will require the use of a mechanical lifting device (forklift, portable cherry picker). Note: Due to space limitations, a mechanical lifting device can not always be used as it can not be positioned appropriately. In this instance, which happens regularly, one or more Heavy Equipment Mechanics will remove or install the part by hand.
8. Several times during step 7, the Heavy Equipment Mechanic will search the shop for shared tools that he must use (1/2 or 3/4-inch impact gun, creeper, snipe or cheater, etc.). **
9. Walk to the Parts Room to order or pick up the required part.
10. Walk back to the shop bay/vehicle/equipment. At this time, if the part is not available, the Heavy Equipment Mechanic will start repairing another vehicle/equipment. Steps 1-9 are repeated on the new vehicle/equipment.
11. Once the parts arrive, the first repair can be completed. Parts are cleaned in the parts washer and reinstalled with the new parts.
12. The vehicle/equipment is then reassembled.
13. Several times during step 12, the Heavy Equipment Mechanic will search the shop for shared tools that he must use (1/2 or 3/4-inch impact gun, creeper, snipe or cheater, etc.). **
14. Test the vehicle/equipment to ensure the repair has been completed satisfactorily.
15. Complete repair report.
16. Repeat steps with the next vehicle/equipment.

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 Heavy Equipment Mechanic works an eight-hour day, Monday to Friday from 0700 to 1530 or 0830 to 1700. He receives a ten-minute rest period in the morning, a 30-minute lunch break and a ten-minute rest period in the afternoon. The Heavy Equipment Mechanic rarely works overtime. Garbage Trucks are usually brought into the shop for repair without having been properly cleaned. Maggots, rats and other disease carrying bacteria have been reported on the surface or in these vehicles. Current parts manuals are not purchased and the Heavy Equipment Mechanic will often make the repair by trial and error. Some manuals and diagrams are difficult to read. There are seven bays for seven Automotive and Heavy Equipment Mechanics.

There are several safety issues in the Automotive/Heavy Equipment Shop. These issues can increase the risk of injury and/or decrease the productivity of the Heavy Equipment Mechanic. These safety issues centre on the lack of adequate workspace for each Heavy Equipment Mechanic to work within. Several vehicles and heavy equipment fill the entire bay. Some are even too large to enter the bay. During normal daily work or in the event of an emergency, access and/or egress in, around or out of the shop is restricted. In



addition, in some instances, where it would be prudent to use a mechanical lifting device, the mechanical lifting device can not get near the vehicle/equipment. When this happens, the Heavy Equipment Mechanic(s) will remove or install the part by hand.

The air exchange system of the Automotive/Heavy Equipment Shop is weak as diesel, gasoline and other fumes hang in the air when the shop doors are open or closed. Lighting has been improved with the installation of overhead mercury vapor lights.

The lack of adequate workspace and ventilation are factors that will negatively affect productivity. The shop bays are often out of service as the Heavy Equipment Mechanic waits for parts to arrive (hours, days). The lack of bays for each Mechanic significantly decreases productivity. Pushing tools boxes from one bay to another is time consuming and access to another bay may be blocked by vehicles or heavy equipment. Working outside in the elements is also likely to negatively affect productivity.

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.

- Walk, stand on concrete floor, asphalt works yard
- Bend, stoop, crouch, kneel and crawl to repair vehicles and equipment
- Reach below, at and above shoulder height to repair vehicles and equipment
- Insert hand(s) into confined areas to repair vehicles and equipment
- Hand, power and air tool use is required
- Climb, stand and balance on ladders or the vehicles and equipment to perform repair
- Work above shoulders in cervical extension from a stand, bend, stoop, crouch, kneel
- Work under vehicles and equipment while they are on the hoist or the shop floor

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.

- Set up vehicle and equipment on the floor or on the hoist
- Some body postures can be selected by the Heavy Equipment Mechanic, but most body postures are the result of how the vehicles and equipment has been engineered

Accommodative Considerations

1. People with injuries to the spine, in any region, may have difficulty with the static and dynamic movements required during the maintenance and repair of vehicles and equipment.
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 to access parts to make repairs.
3. People with forearm and elbow injuries such as tennis elbow may have difficulty with the repeated jarring from air tool use as well as the static grip forces required during any power or hand tool use.



4. People with nerve compression injuries in the upper extremities may have difficulty with the repeated and prolonged use of air tools (compression and vibration).
5. Post-whiplash and other neck problems may have difficulty with this position.
6. Individuals who do not cope in open low-autonomy work environments would have difficulty with this position.
7. Must hold a Tradesman Ticket (Automotive or Heavy Duty Mechanic) valid for the province of British Columbia.

Prepared By: Jeffrey J. McGinn, Kinesiologist

February 15, 1999



Summary of Stresses

Metabolic Stresses

The aerobic energy systems will provide the major source of energy for the Heavy Equipment Mechanic. This position requires a low to moderate level of aerobic activity to perform vehicle and equipment repair. The anaerobic energy system may be used in high intensity repair tasks, such as lifting tires to and from the wheel lugs, lifting parts to and from their proper location or using cheater to loosen or tighten nuts and bolts.

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 Heavy Equipment 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 contributing to deconditioning of 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.

Due to the vehicle and equipment engineering and the space limitations found in the shop, it is almost impossible for the Heavy Equipment Mechanic to use proper postural control and body positioning for most of the work they perform. With this in mind, the goal should be to minimize the time spent in these undesirable, high-risk postures and make good postural and movement choices whenever the situation presents itself.

Neck, Shoulders and Upper Extremity– vehicle maintenance and repair requires prolonged and repeated static and dynamic movements. 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 significant load. Hand, air and power tool use (predominately dominant hand) will increase the static and dynamic loading of the forearm flexors, extensors, supinator, pronator teres and the pronator quadratus. Power and air tool use 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.

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. The awkward positions required to access some parts and components do not allow the Heavy Equipment 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.



INTERVENTIONS

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

1. The present Automotive/Heavy Equipment Shop is inadequate for the type and volume of work that the Automotive Mechanic performs. A larger, space that is more modern is required. This space should be equipped with a proper ventilation system, an effective lighting system and be equipped with the proper number and type of tools and equipment required in a diverse mechanic shop. Floor and overhead hoists require adequate space around them to allow for access and egress. A pit to service vehicles and heavy equipment will decrease the time required to hoist or jack up these pieces for servicing. A stakeholder needs assessment should be conducted to determine the actual requirements of the Automotive/Heavy Equipment Shop. Consult industry to determine space requirements based on the number of mechanics on staff and the footprint of various tools and equipment, etc.
2. Encourage the Heavy Equipment Mechanic to be active away from work focusing on cardiovascular endurance, muscular strength, muscular endurance and flexibility.
3. Provide regular education in effective use of the body and neutral joint positions for this type of work.
4. Encourage the Heavy Equipment Mechanic to ask for assistance when handling heavy and/or oversized parts or pieces of equipment
5. Provide kneepads for the Heavy Equipment Mechanic for the times he will spend in a kneeling position when servicing a vehicle.
6. Purchase current vehicle manuals with easy to read fonts and diagrams.
7. Investigate a padded handle for the pistol grip air tools. Each Heavy Equipment Mechanic may require his own impact gun or changeable grip so that the pistol grip can be matched to the user's handgrip. Investigate the use of a variable speed impact gun to reduce the jarring force at the end of the cycle.

PJDC-Heavy Duty Mechanic

Referral: Lana Ho		Organization: City of Burnaby							Title: Mechanic - Heavy Equipment		
Dept.: Engineering		Division:							Contact:		
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	D		X			20	<1-7	parts, tools, equipment	
	Lifting - Knuckle to Waist	X	D			X		50	<1-7	parts, tools, equipment	
	Lifting - Waist to Shoulder	X	D			X		20	<1-7	parts, tools, equipment	
	Lifting - Over Head	X	D			X		20	<1-7	parts, tools, equipment	
	Carrying - With Handles	X	D		X			10	<1-7	tools	
	Carrying - Without Handles	X	D				X	20	<1-7	parts, tools, equipment	
	Pushing - Upper Extremity	X	D			X		30	<1-7	wrenches, parts into position	
	Pushing - Hip/Leg Assist	X	D			X		50	<1-7	wrenches, parts into position, wheels	
	Pulling - Upper Extremity	X	D			X		30	<1-7	wrenches, parts into position	
	Pulling - Hip/Leg Assist	X	D			X		50	<1-7	wrenches, aprts into position, wheels	
	Reach - Shoulder or Above	X	D				X	20	<1-7	remove/install parts to vehciels/equip.	
	Reach - Sho. or Above extnd	X	D	X				20	<1-7	remove/install parts to vehciels/equip.	
	Reach - Below Shoulder	X	D				X	50	<1-7	remove/install parts to vehciels/equip.	
	Reach - Bel. Shoulder extnd	X	D	X				50	<1-7	remove/install parts to vehciels/equip.	
Handling	X	D				X	50	<1-7	parts, tools, equipment		
Gripping	X	D				X	40	<1-7	parts, tools, equipment		
Fine Finger Movements	X	D				X	max.	low	remove/install parts to vehciels/equip.		
E N R G	Aerobic (percent)	X					90			repair vehicles and equipment	
	Anaerobic (percent)	X			10					heavy lift, pulling wrenches, wrench extensions, etc.	
	High Energy Expenditure	X			X					heavy lift, pulling wrenches, wrench extensions, etc.	
	Low Energy Expenditure	X					X			repair vehicles and 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 vehicles/equipment	
	Neck - Static Neutral	X					X			stand, walk, sit	
	Neck - Static Extension	X					X			access parts/components above shoulders	
	Neck - Rotation	X	L/R				X			to access parts/components in vehicles for repair	
	Throwing										
	Sitting	X			X					to drive vehicle/equipment in/out of shop bay	
	Standing	X					X			on concrete floor, asphalt in works yard, on vehicle	
	Walking	X					X			in shop and works yard on concrete and asphalt	
	Running/Jumping				X					down from vehicles or equipment	
	Climbing - Arms and Legs	X			X					ladders, climb on/in vehicle	
	Climbing - Legs Only	X		X						ladders	
	Bending/Stooping	X					X			make repair, can't stand upright under hoist/vehicles	
	Crouching	X				X				make repair, can't stand upright under hoist/vehicles	
	Kneeling	X			X					to repair vehicle	
Crawling	X		X						possibly to repair vehicle, under vehicle and on back		
Twisting	X	L/R				X			to access parts/components in vehicle for repair		
Balancing	X		X						stand on ladders, vehicles, in engine compartments		
G E N	Traveling										
	Work Alone	X					X			work independently, in shop with others	
	Interact with Public										
	Operate Equip/Machinery	X					X			hoist, power and air tools, vehicles, equipment	
Irregular/Extended Hours										8 hour day, Monday-Friday, 8:30am-5:00pm, no OT	

* 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-Heavy Duty Mechanic

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			co-workers, Foreman, vehicle operator	
	Hearing - Other Sounds	X				X		vehicles moving in shop area	
	Vision - Far	X					X	repair vehicles, clean parts	
	Vision - Near								
	Vision - Colour	X				X		oil, fluid quality	
	Vision - Depth	X					X	repair vehicle, move about in shop/shop area	
	Perception - Spatial	X					X	repair vehicle, move about in shop/shop area	
	Perception - Form	X					X	vehicle parts/components, tools	
W O R K E N V I R O N M E N T	Feeling (Tactile)	X					X	force application to loosen/tighten parts, repair vehicle	
	Reading	X			X			service reports	
	Writing	X			X			service reports	
	Speech	X			X			co-workers, Foreman, vehicle operator	
	Inside Work	X					X	in shop	
	Outside Work	X			X			walk in works yard to find vehicle	
	Hot Conditions >25 deg. C	X	X					spring, summer, fall, shop doors open	
	Cold Conditions <10 deg.C	X	X					fall, winter spring, shop doors open	
	Humid	X	X					wet weather conditions	
	Dust	X			X			possibly when repairing vehicle	
E N V I R O N M E N T	Vapor Fumes	X					X	diesel, gasoline, solvent in parts washer	
	Hazardous Machines	X					X	hoists, floor jacks, hand/power/air tools	
	Proximity to Moving Object	X				X		hoists, floor jacks, hand/power/air tools, vehicles in shop	
	Noise	X					X	power/air tools, running vehicles in shop	
	Electrical Hazard								
	Sharp Tools	X				X		hand/power/air tools to repair vehicle	
	Radiant/Thermal Energy	X			X			hot motor or parts on vehicle, hot oil, fluid	
	Slippery Conditions	X					X	oil, fluid, water on shop floor	
	Vibration and Related	X				X		power and air tool use	
	Chemical Irritants	X				X		oil, transmission fluid, windshield washer fluid, antifreeze	
E N V I R O N M E N T	Organic Substances	X	X					when repairing garbage trucks	
	Medical Waste								
	Blood Products								
	Congested Worksite	X					X	in shop and in service bay area	
	Lighting - Direct	X					X	overhead fluorescent and mercury vapor lights	
	Lighting - Indirect	X					X	daylight from open shop doors	
	Lighting - Adjustable	X					X	trouble lights	
	Lighting - Fluorescent	X					X	overhead fluorescent lights	
	Lighting - Incandescent								
	Lighting - Shadows etc.	X					X	under vehicle, working under the hood of vehicle	

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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