

TASK ANALYSIS WORKSHEET

Company: The Corporation of Delta  
 Job Title: Hydrant Maintenance

Department: Utility Maintenance  
 Date: August 22, 2002

**Job Summary:**

Hydrant Maintenance is done on an annual basis and requires a 2-person crew to perform the following primary tasks:

- Set-up worksite and tools
- Pressurize Hydrant (pressurize, release water pressure)
- Shut off water
- Dismantle Hydrant (includes removing shaft)
- Inspect, Clean, Replace Parts, Apply Lubricant
- Reassemble Hydrant (includes replacing shaft)
- Turn on water



Secondary tasks include driving between sites and ensuring there is good access to the hydrant e.g. soil, grass, weeds and clearing debris as required.

Two types of hydrants are maintained – Compression Hydrants and Slide Gate Hydrants. Note: Employees associate the Compression Hydrants with increased physical demands of work.

Intact hydrant heights range from between 76 cm (30”) and 104 cm (41”). The hydrant shaft length varies and range from 7.5 feet to 14 feet (depending on the depths of the water line). The shaft weight exceeded the force gauge used during the assessment (force gauge maximum 28 kg./60 lb) and was estimated by employees as weighing up to 45 kg/100 lb.

Job tasks are shared between the two crew members. A routine and pattern has developed, and the work proceeds efficiently, e.g. while one crew member is getting the tools set-up and finding the water access; the second crew will begin pressurizing the hydrant etc.

Between 11 and 14 hydrants are maintained per day. On average, each hydrant takes between 20 to 25 minutes to complete. The drive between sites varies but appeared to be of short duration (5 minutes). This Hydrant maintenance program occurs for approximately a 4 week period during the summer months (duration time may vary).

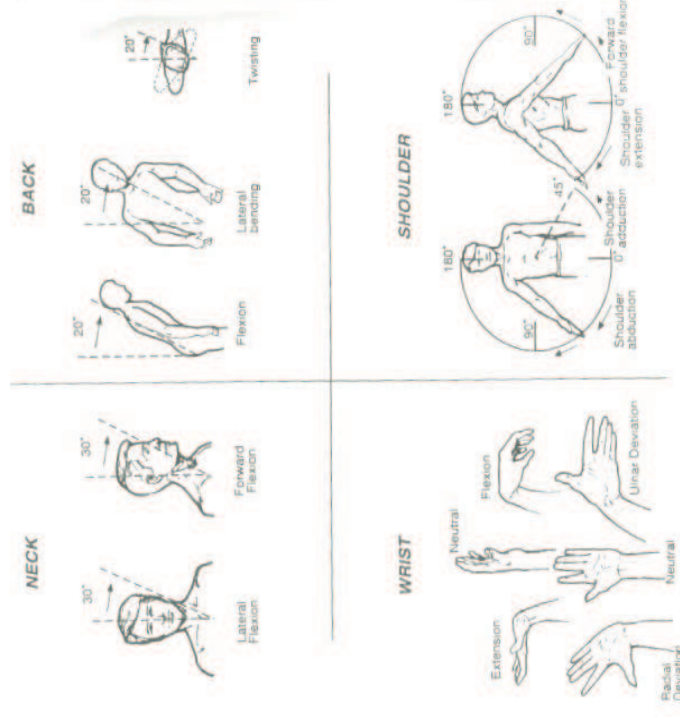
The truck tailgates are outfitted with a rack and clamp to place the shaft for specific maintenance tasks. All other tools are stored in the rear of the truck.

Tasks & Description of Activities	Frequency	Duration
<p>The following tasks are described as observed of the two crews viewed. Activities or assignment of duties may vary between crews. For the purposes of this report, the two crew members have been numbered as <b>crew #1 and crew #2</b> to differentiate job task assignment and workload. Some tasks are performed simultaneously. Frequency percentages are based on NIOSH and Department of Labour guidelines.</p> <p><b>1. Set-up tools (crew #1)</b></p> <ul style="list-style-type: none"> <li>▪ Assemble tools               <ul style="list-style-type: none"> <li>- T-wrench (&lt; 1 kg.)</li> <li>- Hydrant wrench (&lt;1 kg.)</li> <li>- Pressure gauge (&lt;1 kg.)</li> <li>- Valve key (6 feet long)</li> <li>- Canada Valve Key (7 kg.)</li> <li>- Speed wrench (&lt;1 kg.)</li> <li>- 17" wrench (2.5 kg.)</li> <li>- other assorted small wrenches, wire brush, screw driver</li> <li>- mallet</li> </ul> </li> </ul>	<p>11 - 14 times per day (0-33 % of shift)</p>	<ul style="list-style-type: none"> <li>▪ 2-3 minutes</li> <li>▪ 27.5 minutes to 35 minutes / shift (intermittent)</li> </ul>
<p><b>2. Pressurize Hydrant (crew #2)</b></p> <ul style="list-style-type: none"> <li>• Loosen port taps (2) with hydrant wrench (10 kg. pull force)</li> <li>• Remove side port tap</li> <li>• Screw on pressure gauge to pressurize hydrant</li> <li>• Release pressure and open pressure gauge (after water is shut off)</li> </ul>	<p>11 - 14 times per day (0-33 % of shift)</p>	<ul style="list-style-type: none"> <li>▪ 2-3 minutes</li> <li>▪ 27.5 minutes to 35 minutes / shift (intermittent)</li> </ul>
<p><b>3. Shut off water (crew #1)</b></p> <ul style="list-style-type: none"> <li>▪ Lift valve box lid with T wrench (17 kg. lifting force)</li> <li>▪ Shut off water with valve key (19 kg. torque force – varies)</li> </ul>	<p>11 - 14 times per day (0-33 % of shift)</p>	<ul style="list-style-type: none"> <li>▪ 2-3 minutes</li> <li>▪ 27.5 minutes to 35 minutes / shift (intermittent)</li> </ul>

Tasks & Description of Activities	Frequency	Duration
<p><b>4. Dismantle Hydrant (crew #2)</b></p> <ul style="list-style-type: none"> <li>▪ Remove “O” ring</li> <li>▪ Unscrew and remove hydrant head (11 kg.)</li> <li>▪ Undue nuts (6 to 12 per hydrant)</li> <li>▪ Insert T-wrench (20+ turns)</li> <li>▪ Lift and remove vertical shaft hand over hand (7.5 to 14 feet long, weight &gt;28 kg.)</li> </ul> <p>Note: while 1 crew lifts the shaft upright, the second crew may assist with lowering it to a horizontal position, usually placing it across the top of the hydrant.</p>	<p>11- 14 times per day (34-66% % of shift)</p>	<ul style="list-style-type: none"> <li>▪ 5-10 minutes</li> <li>▪ 82.5 – 105 minutes / shift (intermittent)</li> </ul>
<p><b>5. Inspect, Clean, Replace Parts, Apply Lubricate (crew #2)</b></p> <ul style="list-style-type: none"> <li>▪ Clean end with wire brush</li> <li>▪ Inspect for wear and tear</li> <li>▪ Replace necessary parts</li> <li>▪ Apply lubricant</li> </ul>	<p>11- 14 times per day (0-33 % of shift)</p>	<ul style="list-style-type: none"> <li>▪ 3-5 minutes</li> <li>▪ 44 – 56 minutes / shift (intermittent)</li> </ul>
<p><b>6. Reassemble Hydrant (crew #2 with assistance from crew #1)</b></p> <ul style="list-style-type: none"> <li>▪ Replace shaft: <ul style="list-style-type: none"> <li>- Lift shaft upright (vertical) from horizontal position (2<sup>nd</sup> crew may assist)</li> <li>- Insert base into hydrant</li> <li>- Lower into place (using couplings as grasp points) lowering hand over hand</li> <li>- Tighten with T-wrench (20 + turns)</li> </ul> </li> <li>▪ Replace nuts (6-12 per hydrant)</li> <li>▪ Replace hydrant head (11 kg.)</li> <li>▪ Replace “O” ring</li> <li>▪ Remove pressure gauge</li> <li>▪ Replace and tighten side port tapes</li> </ul>	<p>11- 14 times per day (34-66% % of shift)</p>	<ul style="list-style-type: none"> <li>▪ 5-10 minutes</li> <li>▪ 82.5 – 105 minutes / shift (intermittent)</li> </ul>
<p><b>7. Turn on Water (crew #1)</b></p> <ul style="list-style-type: none"> <li>▪ Turn on water with valve key (force varies)</li> <li>▪ Replace valve box lid with T wrench (17 kg. lifting force)</li> </ul>	<p>11- 14 times per day (0-33 % of shift)</p>	<ul style="list-style-type: none"> <li>▪ 2-3 minutes</li> <li>▪ 27.5 minutes to 35 minutes / shift (intermittent)</li> </ul>

### Risk Factors considered:

- Joint posture: wrist, elbow, shoulder, neck, back, knees
- Awkward posture: reach, twist, bend, stoop, squat, climb, static, dynamic
- Force: lift, lower, carry, push/pull, pinch or power grip
- Repetition: frequency, duration
- Contact Stress
- Object weight, location, size, shape, handles, stability of load
- Work height, layout, seating, space
- Tool/equipment use
- Environment: layout, flooring, temperature, noise, light, glare, vibration
- Work Organization: recovery, schedule, workload, task variability, pace, PPE use, interruptions



*Postures, WCB of BC*

<p><b>Department/Work Area:</b> Engineering Operations, Utility Maintenance  <b>Specific Location:</b> North Delta (assorted), Annicis Island (assorted)  <b>Assessed By:</b> B. De Jong</p>	<p><b>Occupation:</b> Labourer – Hydrant Maintenance  <b>Contact Name:</b>  <b>Assessment Date:</b> August 22, 2002</p>
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<p><b>Description of work area:</b> Outdoor roadside urban and industrial park location. Weather sunny, dry, temp. 20-25 degrees Celsius.  <b>Hours of Work/Shift Schedule:</b> 7:00 a.m. to 2:30 p.m.  <b>MSI signs / symptoms noted:</b> back, neck, shoulder and arm/wrist</p>
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Tasks for Ergonomics Risk Assessment (from Task Analysis worksheet):		Frequency / Duration of Task:
1. Set-up		< 1 hour/day
2. Pressurize Hydrant		0-33% of shift
3. Shut off water		< 1 hour/day
4. Dismantle Hydrant		< 1 hour/day
5. Inspect, Clean, Replace Parts, Lubricate		1-3 hours/day
6. Reassemble Hydrant		< 1 hour/day
7. Turn on water		1-3 hours/day
		< 1 hour/day

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
<p><b>1. Set-up - assemblies tools (crew #1)</b></p>	<p>Awkward Posture:</p> <ul style="list-style-type: none"> <li>▪ Back flexion</li> <li>▪ Shoulder flexion</li> </ul>	<p>2-3 minute duration</p> <p>0-33% of shift</p>	<p>Dynamic (&lt;30 sec.)</p> <ul style="list-style-type: none"> <li>▪ Back flexion 10-45°</li> <li>▪ Shoulder flexion 45 - 90°</li> </ul> <p>Reach:</p> <ul style="list-style-type: none"> <li>▪ 12 to 24 inches (may be longer)</li> </ul>	<p style="text-align: center;"><b>Assessment</b></p>	<ul style="list-style-type: none"> <li>▪ Lifts and carries tools from back of truck to ground.</li> <li>▪ Truck tailgate height is below waist height at / or around knuckle height.</li> <li>▪ Short distance walking on combination of pavement and grass.</li> <li>▪ Some reach distances into the truck may exceed recommended guidelines; however, most tools were placed within easy reach.</li> </ul> <p>The dynamic nature and frequency and duration of the tasks do not exceed ergonomic guidelines for awkward postures (WCB Worksheet B).</p>

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments	
Set-up continued...	Force: <ul style="list-style-type: none"> <li>Lifting assorted tools</li> </ul>	2-3 minute duration 0-33% of shift	Weights range from <1kg. - 7 kg.	<b>Assessment</b>	<ul style="list-style-type: none"> <li>Majority of the tools weigh &lt; 1 kg. each. The 17" wrench weighs 2.5 kg. and the Canada Valve key weighs 7 kg.</li> </ul> The lifts are within recommended weight limits for lifting tasks (WCB Worksheet B).	
	Repetition: <ul style="list-style-type: none"> <li>Performs a variety of movements</li> </ul>	2-3 minute duration 0-33% of shift				Not considered repetitive work.  The frequency and duration of the tasks does not exceed ergonomic guidelines for repetition (WCB Worksheet B).
	Grip Force: <ul style="list-style-type: none"> <li>Grasps tools (carrying)</li> </ul>	2-3 minute duration 0-33% of shift	<ul style="list-style-type: none"> <li>Power grip / short duration</li> </ul>			<ul style="list-style-type: none"> <li>Power grips an object weighing &gt; 5 kg. with neutral wrists.</li> </ul> The dynamic nature and frequency and duration of the task do not indicate this as high risk for grip force.
<b>2. Pressurize Hydrant (crew #2)</b>	Awkward Posture: <ul style="list-style-type: none"> <li>Back flexion</li> <li>Neck flexion</li> <li>Shoulder flexion</li> <li>Shoulder abduction &amp; rotation</li> <li>Wrist flexion</li> <li>Forearm rotation</li> </ul>	2-3 minute duration 0-33% of shift	Static (>30 sec.) <ul style="list-style-type: none"> <li>Back flexion 30 - 90°</li> <li>Neck flexion 30 - 45°</li> </ul> Dynamic <ul style="list-style-type: none"> <li>Shoulder flexion 10-45°</li> <li>Shoulder abduction &gt;45°</li> <li>Wrist flexion 45°</li> <li>Forearm rotation</li> </ul>		<ul style="list-style-type: none"> <li>Static back and neck flexion while bending to 30"-41" high hydrant.</li> <li>Dynamic shoulder abduction and rotation when using hydrant wrench.</li> <li>Wrist flexion with power grip on wrench and when screwing on pressure gauge.</li> </ul> The frequency and duration of the tasks does not exceed ergonomic guidelines for awkward postures. Able to pause and change position as required.	

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment/Observations/Comments
<p><b>Pressurize Hydrant continued...</b></p>	<p>Force:</p> <ul style="list-style-type: none"> <li>▪ Pull /push force on hydrant wrench</li> <li>▪ Grip force on hydrant wrench and when hand turning port taps and pressure gauge</li> </ul>	<p>2-3 minute duration 0-33% of shift</p>	<p>10 kg. pull force with wrench Power grip with 30° bent wrist</p>	<ul style="list-style-type: none"> <li>▪ Hydrant wrench pull force of 10 kg. (initial)</li> <li>▪ Pull force is reduced once port taps are loosened.</li> <li>▪ Power grips an object weighing &lt; 5 kg. with bent wrist (WCB of BC, Worksheet B)</li> </ul> <p>One hand pull force, exerted less than once per minute, is within the recommended value of 10 kg. (females/Mital).</p> <p>The frequency and duration of the tasks does not exceed ergonomic guidelines for grip force (WCB Worksheet B).</p>
	<p>Repetition:</p> <ul style="list-style-type: none"> <li>▪ Shoulders</li> <li>▪ Elbows</li> <li>▪ Wrists</li> <li>▪ Hands</li> </ul>	<p>2-3 minute duration 0-33% of shift</p>	<ul style="list-style-type: none"> <li>▪ Wrist flexion &gt;30°</li> <li>▪ Wrist deviation &gt;30°</li> <li>▪ Shoulder abduction / rotation</li> <li>▪ Forceful hand exertions.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Combination of tool use and direct hand / finger movements.</li> </ul> <p>The frequency and duration of the tasks does not exceed ergonomic guidelines for repetition (WCB Worksheet B).</p>



Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
<p><b>3. Shut off Water (crew #1)</b></p>	<p>Awkward Posture</p> <ul style="list-style-type: none"> <li>▪ Neck flexion</li> <li>▪ Back flexion</li> <li>▪ Shoulder flexion</li> <li>▪ Shoulder abduction</li> <li>▪ Wrist flexion</li> <li>▪ Forearm rotation</li> <li>▪ Knees (squatting / kneeling)</li> </ul>	<p>2-3 minute duration</p> <p>0-33% of shift</p>	<p>Static (&gt;30 sec.)</p> <ul style="list-style-type: none"> <li>▪ Back flexion 30 - 45°</li> <li>▪ Neck flexion 30 - 45°</li> </ul> <p>Dynamic</p> <ul style="list-style-type: none"> <li>▪ Shoulder flexion 10-45°</li> <li>▪ Shoulder abduction &gt;45°</li> <li>▪ Wrist flexion / extension 45°</li> <li>▪ Forearm rotation</li> </ul>		<ul style="list-style-type: none"> <li>▪ May be required to squat or kneel to access / remove valve box lid.</li> <li>▪ Valve key height to turn off water will vary depending on depth of water line – generally at or below shoulder height.</li> </ul> <p>The frequency and duration of the tasks does not exceed ergonomic guidelines for awkward postures. Able to pause and change position as required.</p>
<p><b>Identification</b></p>	<p>Force</p> <ul style="list-style-type: none"> <li>▪ Grip force</li> <li>▪ Pull force</li> <li>▪ Lifting</li> </ul>	<p>2-3 minute duration</p> <p>0-33% of shift</p>	<ul style="list-style-type: none"> <li>▪ Valve box lid weight =17 kg.</li> <li>▪ 19 kg. peak pull force (initial) with valve key (may vary)</li> </ul>	<p><b>Assessment</b></p>	<ul style="list-style-type: none"> <li>▪ Valve box lid may require being jarred loose by forceful mallet hits.</li> <li>▪ Gloves are not worn when lifting or pulling/pushing on valve key.</li> <li>▪ Power grips an object weighing 5 kg. or more with bent wrist (WCB Worksheet B)</li> </ul> <p>The frequency and duration of the tasks does not exceed ergonomic guidelines for grip force</p> <p>Valve box lid weight for lifting is within recommended weight limits based on the frequency and duration of task. (WCB of BC, Worksheet B).</p> <p>Recommended bilateral arm strength forces for pushing and pulling at waist height is 14 kg. (97<sup>th</sup> percentile male or female). This force is exceeded when turning valve key (Human scale/Human Strength) and may create risk of shoulder, wrist or back injury.</p>



Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
Shut off Water continued...	Repetition <ul style="list-style-type: none"> <li>▪ Shoulders</li> <li>▪ Elbows</li> <li>▪ Wrists</li> <li>▪ Hands</li> </ul>	2-3 minute duration 0-33% of shift	An average of 20-25 turns of the valve key is required. <ul style="list-style-type: none"> <li>▪ Wrist flexion &gt;30°</li> <li>▪ Wrist deviation &gt;30°</li> <li>▪ Shoulder abduction / rotation</li> <li>▪ Forceful hand exertions.</li> </ul>		The frequency and duration of the tasks does not exceed ergonomic guidelines for repetition (WCB Worksheet B).
Identification 4. Dismantle Hydrant (Crew #2)	Awkward Posture <ul style="list-style-type: none"> <li>▪ Back flexion</li> <li>▪ Back extension</li> <li>▪ Neck flexion</li> <li>▪ Shoulder flexion</li> <li>▪ Shoulder abduction &amp; rotation</li> <li>▪ Wrist flexion</li> <li>▪ Forearm rotation</li> </ul>	5-10 minute duration 34-66% of shift	Static (>30 sec.) <ul style="list-style-type: none"> <li>▪ Back flexion 30 - 90°</li> <li>▪ Neck flexion 30 - 45°</li> <li>▪ Back extension &gt; 20°</li> </ul> Dynamic <ul style="list-style-type: none"> <li>▪ Shoulder flexion 10-90°</li> <li>▪ Shoulder abduction &gt;45°</li> <li>▪ Wrist flexion 45°</li> <li>▪ Forearm Rotation</li> </ul>	Assessment	<ul style="list-style-type: none"> <li>▪ Static back and neck flexion while bending to 30"-41" high hydrant.</li> <li>▪ Dynamic shoulder abduction and rotation and overhead reaching when removing shaft.</li> <li>▪ Wrist flexion with power grip on wrench (6-10 turns).</li> <li>▪ Wrist flexion with pinch grip when undoing nuts (6-12)</li> <li>▪ Back extension occurs when lifting vertical shaft.</li> <li>▪ Employee comments that Compression Hydrant requires more effort and work to dismantle (# screws, shaft length)</li> </ul> Awkward postures (performed for >25% of work shift) in combination with forceful, heavy work exceed ergonomic guidelines and may increase risk of injury to back, wrist and shoulders (WCB/NIOSH/CDC).

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
<p><b>Dismantle hydrant continued...</b></p>	<p>Force</p> <ul style="list-style-type: none"> <li>▪ Grip force</li> <li>▪ Pull force</li> <li>▪ Lifting</li> </ul>	<p>5-10 minute duration 34-66% of shift</p>	<ul style="list-style-type: none"> <li>▪ Power grip of wrench</li> <li>▪ Pull force of 23 kg. (one hand) to remove nuts</li> <li>▪ Lift / lower hydrant head (11 kg.)</li> <li>▪ Release shaft with T-wrench (20 + turns)</li> <li>▪ Lift vertical shaft 7.5 to 14 feet long. Estimated weight up to 45 kg.</li> </ul>	<p><b>Assessment</b></p>	<ul style="list-style-type: none"> <li>▪ Gloves are not worn</li> <li>▪ Power grips an object weighing 5 kg. or more with bent wrist (WCB Worksheet B).</li> <li>▪ One hand (dominant) pull force obtained at 23 kg.</li> <li>▪ T-wrench force unable to obtain.</li> <li>▪ Hydrant head lift/lower is within recommended guidelines.</li> <li>▪ Lifts shaft hand over hand (uses couplings to support hand grip) extending back to maintain balance. Shifts the shaft up and out to place horizontally on top of hydrant. Second crew may assist with lowering. May carry to tail gate of truck for specific tasks.</li> </ul> <p><u>Grip Force:</u> The frequency and duration of the tasks does not exceed ergonomic guidelines for grip force</p> <p><u>Pull Force – One Hand (Remove Nuts):</u> One hand pull force exceeds the recommended value of 10 kg. (females/Mital) and may increase risk of injury to wrist or shoulder.</p> <p><u>T-Wrench (unable to measure force):</u> Recommended bilateral arm strength forces for pushing and pulling at waist height is 14 kg. (97<sup>th</sup> percentile male or female). If this force is similar to turning the valve key it will exceed recommended guidelines (Human scale/Human Strength).</p> <p><u>Lift Shaft:</u> Weight for lifting the shaft exceeds recommended weight limits (WCB/NIOSH) and may increase risk of back and shoulder injury. Lifting in combination with awkward postures will increase risk.</p>

	Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
Identification	Dismantle hydrant continued...	Repetition	5-10 minute duration 34-66% of shift	<ul style="list-style-type: none"> <li>▪ O ring 6 - 10 movements</li> <li>▪ Nuts multiple movements</li> <li>▪ T-wrench 20+ movements</li> <li>▪ Wrist flexion &gt;30°</li> <li>▪ Wrist deviation &gt;30°</li> <li>▪ Shoulder abduction / rotation</li> <li>▪ Forceful hand exertions.</li> </ul>		<ul style="list-style-type: none"> <li>▪ Removal of "O" ring requires 6-10 turns with speed wrench</li> <li>▪ Compression Hydrant requires removal of 12 nuts.</li> <li>▪ Slide Gate Hydrant requires removal of 6 nuts.</li> <li>▪ Compression Hydrant requires more repetitive movements.</li> <li>▪ Combination of tool use and direct hand / finger movements to remove nuts.</li> </ul> <p>Not considered repetitive work (repeated every 30 seconds of work cycle or for more than 50% of shift/ Silverstein).</p> <p>Another guideline indicates high repetition is 1000 wrist motions with force per hour (Wick).</p>
	5. Inspect / clean / replace parts / lubricate (crew # 2)	Awkward Posture <ul style="list-style-type: none"> <li>▪ Back flexion</li> <li>▪ Neck flexion</li> <li>▪ Shoulder flexion</li> <li>▪ Shoulder abduction &amp; rotation</li> <li>▪ Wrist flexion</li> <li>▪ Forearm rotation</li> </ul>	3-5 minutes duration (average) 0-33% of shift	Static (>30 sec.) <ul style="list-style-type: none"> <li>▪ Back flexion 30 - 90°</li> <li>▪ Neck flexion 30 - 45°</li> </ul> Dynamic <ul style="list-style-type: none"> <li>▪ Shoulder flexion 10-90°</li> <li>▪ Shoulder abduction &gt;45°</li> <li>▪ Wrist flexion 45°</li> <li>▪ Forearm rotation</li> </ul>		<ul style="list-style-type: none"> <li>▪ Static back and neck flexion while bending to 30"-41" high hydrant.</li> <li>▪ Dynamic shoulder abduction and rotation when using tools or wire brush.</li> <li>▪ Wrist flexion with power and pinch grip when using tools or wire brush.</li> <li>▪ May work from tail gate of truck for specific tasks.</li> </ul> <p>The frequency and duration of the tasks does not exceed ergonomic guidelines for awkward postures. Able to pause and change position as required.</p>

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
<p><b>Inspect etc. continued...</b></p>	<p>Force</p> <ul style="list-style-type: none"> <li>▪ Pinch grip</li> <li>▪ Power grip</li> </ul>	<p>3-5 minutes duration (average)</p> <p>0-33% of shift</p>	<ul style="list-style-type: none"> <li>▪ Pinch Grip &lt; 1kg.</li> <li>▪ Power Grip &lt; 5 kg.</li> </ul>		<ul style="list-style-type: none"> <li>▪ Use of hand tools and wire brush</li> </ul> <p>The dynamic nature and frequency and duration of the task do not indicate this as high risk for grip force.</p>
	<p>Repetition:</p> <ul style="list-style-type: none"> <li>▪ Shoulders</li> <li>▪ Elbows</li> <li>▪ Wrists</li> <li>▪ Hands</li> </ul>	<p>3-5 minutes duration (average)</p> <p>0-33% of shift</p>	<ul style="list-style-type: none"> <li>▪ Wrist flexion &gt;30°</li> <li>▪ Wrist deviation &gt;30°</li> <li>▪ Shoulder abduction / rotation</li> <li>▪ Forceful hand exertions.</li> </ul>		<ul style="list-style-type: none"> <li>▪ Combination of tool use and direct hand / finger movements.</li> </ul> <p>The frequency and duration of the tasks does not exceed ergonomic guidelines for repetition (WCB Worksheet B).</p>
<p><b>6. Reassemble Hydrant (crew #2)</b></p>	<p>Awkward Posture</p> <ul style="list-style-type: none"> <li>▪ Back flexion</li> <li>▪ Neck flexion</li> <li>▪ Shoulder flexion</li> <li>▪ Shoulder abduction &amp; rotation</li> <li>▪ Wrist flexion</li> <li>▪ Forearm rotation</li> </ul>	<p>5-10 minute duration</p> <p>34-66% of shift</p>	<p>Static (&gt;30 sec.)</p> <ul style="list-style-type: none"> <li>▪ Back flexion 30 - 90°</li> <li>▪ Neck flexion 30 - 45°</li> </ul> <p>Dynamic</p> <ul style="list-style-type: none"> <li>▪ Shoulder flexion 10-90°</li> <li>▪ Shoulder abduction &gt;45°</li> <li>▪ Wrist flexion 45°</li> <li>▪ Forearm rotation</li> </ul>	<p><b>Reverse of Task # 4 – Dismantle Hydrant</b></p> <ul style="list-style-type: none"> <li>▪ Static back and neck flexion while bending to 30"-41" high hydrant.</li> <li>▪ Dynamic shoulder abduction and rotation and overhead reaching when replacing shaft.</li> <li>▪ Wrist flexion with power grip on wrench (6-10 turns).</li> <li>▪ Wrist flexion with pinch grip when tightening nuts (6-12)</li> <li>▪ Employee comments that Compression Hydrant requires more effort and work to reassemble (# screws, shaft length)</li> </ul> <p>Awkward postures (performed for &gt;25% of work shift) in combination with forceful, heavy work exceeds ergonomic guidelines and may increase risk of injury to back, wrist and shoulders (WCB/NIOSH/CDC).</p>	

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
<p><b>Reassemble Hydrant continued...</b></p>	<p>Force</p> <ul style="list-style-type: none"> <li>▪ Grip force</li> <li>▪ Pull force</li> <li>▪ Lifting</li> </ul>	<p>5-10 minute duration 34-66% of shift</p>	<ul style="list-style-type: none"> <li>▪ Lift vertical shaft 7.5 to 14 feet long. Estimated weight up to 45 kg.</li> <li>▪ Tighten shaft with T - wrench (20+ turns)</li> <li>▪ Lift / lower hydrant head (11 kg.)</li> <li>▪ Push force of to replace nuts</li> <li>▪ Power grip of wrench</li> </ul>	<p><b>Reverse of Task # 4 – Dismantle Hydrant</b></p>	<p>Less force is required to tighten shaft and replace nuts.</p> <p>Other crew member may assist with lifting the shaft upright. However, once the shaft is being lowered there is only room for one crew member (crew #2).</p> <p>The shaft may need to be lifted and lowered several inches to ensure it is in fitting at base.</p> <p><u>Lift and Lower Shaft:</u> Weight for lifting the shaft exceeds recommended weight limits (WCB/NIOSH) and may increase risk of back and shoulder injury. Lifting in combination with awkward postures will increase risk.</p>
<p><b>Identification</b></p>	<p>Repetition</p>	<p>5-10 minute duration 34-66% of shift</p>	<ul style="list-style-type: none"> <li>▪ T-wrench 20+ movements</li> <li>▪ Nuts multiple movements</li> <li>▪ O ring 6 - 10 movements</li> <li>▪ Wrist flexion &gt;30°</li> <li>▪ Wrist deviation &gt;30°</li> <li>▪ Shoulder abduction / rotation</li> <li>▪ Forceful hand exertions.</li> </ul>	<p><b>Reverse of Task # 4 – Dismantle Hydrant</b></p>	<p>Not considered repetitive work (repeated every 30 seconds of work cycle or for more than 50% of shift/ Silverstein).</p>

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment	Assessment/Observations/Comments
<p><b>4. Turn On Water (crew #1)</b></p>	<p>Awkward Posture</p> <ul style="list-style-type: none"> <li>▪ Neck flexion</li> <li>▪ Back flexion</li> <li>▪ Shoulder flexion</li> <li>▪ Shoulder abduction</li> <li>▪ Wrist flexion</li> <li>▪ Forearm rotation</li> <li>▪ Knees (squatting / kneeling)</li> </ul>	<p>2-3 minute duration</p> <p>0-33% of shift</p>	<p>Static (&gt;30 sec.)</p> <ul style="list-style-type: none"> <li>▪ Back flexion 30 - 45°</li> <li>▪ Neck flexion 30 - 45°</li> </ul> <p>Dynamic</p> <ul style="list-style-type: none"> <li>▪ Shoulder flexion 10-45°</li> <li>▪ Shoulder abduction &gt;45°</li> <li>▪ Wrist flexion / extension 45°</li> <li>▪ Forearm rotation</li> </ul>		<p><b>Reverse of Task # 3 – Turn off Water</b></p> <ul style="list-style-type: none"> <li>▪ Valve key height to turn on water will vary depending on depth of water line – generally at or below shoulder height.</li> <li>▪ May be required to squat or kneel to access / replace valve box lid.</li> </ul> <p>The frequency and duration of the tasks does not exceed ergonomic guidelines for awkward postures. Able to pause and change position as required.</p>
<p><b>Identification</b></p>	<p>Force</p> <ul style="list-style-type: none"> <li>▪ Grip force</li> <li>▪ Push force</li> <li>▪ Lifting</li> </ul>	<p>2-3 minute duration</p> <p>0-33% of shift</p>	<ul style="list-style-type: none"> <li>▪ Valve box lid weight =17 kg.</li> <li>▪ Push force to turn valve key (unable to obtain)</li> </ul>		<p>The frequency and duration of the tasks does not exceed ergonomic guidelines for grip force</p> <p>Less force is required to tighten with valve key. Unable to measure force.</p> <p>Valve box lid weight for lifting is within recommended weight limits based on the frequency and duration of task. (WCB Worksheet B).</p>

Task	Risk Factors	Freq/Dur	Mag/Range	Assessment/Observations/Comments
<p>Turn on Water continued...</p>	<p>Repetition</p> <ul style="list-style-type: none"> <li>▪ Shoulders</li> <li>▪ Elbows</li> <li>▪ Wrists</li> <li>▪ Hands</li> </ul>	<p>2-3 minute duration</p> <p>0-33% of shift</p>	<p>An average of 20-25 turns of the valve key is required.</p> <ul style="list-style-type: none"> <li>▪ Wrist flexion &gt;30°</li> <li>▪ Wrist deviation &gt;30°</li> <li>▪ Shoulder abduction / rotation</li> <li>▪ Forceful hand exertions.</li> </ul>	<p>The frequency and duration of the tasks does not exceed ergonomic guidelines for repetition (WCB Worksheet B).</p>



**SUMMARY**

The risk identification and assessment for Hydrant Maintenance job tasks have identified some risk factors that exceed recommended guidelines. While the job tasks have been assessed individually and by crew number, cumulative effects of combined tasks may increase the level of risk.

Crew #1 performs the following primary tasks:	Status / Risk	Crew #2 performs the following primary tasks:	Status / Risk
<ul style="list-style-type: none"> <li>▪ Set up</li> </ul>	<ul style="list-style-type: none"> <li>▪ Minimal risk</li> </ul>	<ul style="list-style-type: none"> <li>▪ Pressurize hydrant</li> </ul>	<ul style="list-style-type: none"> <li>▪ Minimal Risk</li> </ul>
<ul style="list-style-type: none"> <li>▪ Water shut off</li> </ul>	<ul style="list-style-type: none"> <li>▪ Exceeds</li> </ul>	<ul style="list-style-type: none"> <li>▪ Dismantle hydrant</li> </ul>	<ul style="list-style-type: none"> <li>▪ Exceeds</li> </ul>
<ul style="list-style-type: none"> <li>▪ Water turn on</li> </ul>	<ul style="list-style-type: none"> <li>▪ Minimal risk</li> </ul>	<ul style="list-style-type: none"> <li>▪ Inspect, clean, replace parts, apply lubricant</li> <li>▪ Reassemble hydrant</li> </ul>	<ul style="list-style-type: none"> <li>▪ Minimal Risk</li> <li>▪ Exceeds</li> </ul>
<p><u>Secondary Tasks:</u></p>	<ul style="list-style-type: none"> <li>▪ Minimal risk</li> </ul>	<p><u>Secondary Tasks:</u></p>	<ul style="list-style-type: none"> <li>▪ Minimal Risk</li> </ul>
<ul style="list-style-type: none"> <li>▪ Driving</li> </ul>		<ul style="list-style-type: none"> <li>▪ May drive</li> </ul>	
<ul style="list-style-type: none"> <li>▪ Clean up (return tools to truck)</li> </ul>		<ul style="list-style-type: none"> <li>▪ Clean up (return tools to truck)</li> </ul>	
<ul style="list-style-type: none"> <li>▪ Assist Crew #2 as required (usually during shaft lift/lower)</li> </ul>			

**Crew #1:**

Crew #1 exceeds recommended guidelines for force (turning valve key) when shutting off the water. This may increase risk of shoulder, wrist or back injury.

Additionally, cumulative effects of awkward postures of the back, neck, shoulder and wrist may increase the risk of injury (34-66% of shift when activities or tasks combined). Recovery time between tasks should minimize the risk.

**Crew #2:**

Crew #2 exceeds recommended guidelines for awkward posture and force (lifting, grasping, pushing, pulling) when dismantling and reassembling the hydrant. The combined exposure to several physical risk factors may increase the risk of back, neck, shoulder and wrist/arm injury.

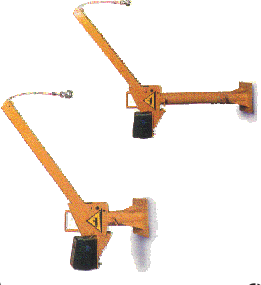
Additionally, while not exceeding guidelines for the individual tasks, cumulative effects of awkward postures of the neck, back, shoulder and arm/wrist may increase the risk of injury (> 66% of shift when all activities or tasks are combined).

**CONTROLS**

Recommendations for control of identified risk factors will focus on methods to minimize risk. The Hydrant Maintenance crews perform heavy physical labor over a dedicated period of time (summer months). Subjective comments from the crews support the identified risk factors.

*\*Control Priority Note: 1 = recommended for implementation to reduce risk factors; 2 = optional, for consideration as a means of reducing risk factors; 3 = not for immediate action but for future consideration as appropriate.*

<b>Risk Factor</b>	<b>Recommended Controls</b>	<b>Control Priority*</b>	<b>Responsible Person</b>	<b>Status</b>
Endurance for physically demanding work	Maintain an increased level of fitness focusing on cardiovascular and muscular endurance and muscular flexibility. This is especially important for new crew members who may not be acclimatized to the demands of work.	2	Employee	
Preparation for all physically demanding work	Develop a physical warm up program specific to the demands of the job. Workers should perform this warm up prior to the start of the day and before resuming work following >30 min. breaks. The duration of the warm up is less than 10 min. Micro stretches should also be performed following static, awkward postures e.g. neck and back bending.	2	Superintendent / Safety Dept.	
Force: Tools and equipment	Ensure all tools and equipment are in good shape and repair. Static forces will increase if tools and equipment require more work or repetition of work due to poor maintenance including cleaning.	1	Superintendent Employee	
Awkward and Static Postures	Evaluate tools and equipment when being replaced to ensure the weight and design (e.g. grip) will reduce the workload (e.g. wrenches, valve key etc.). Consider job rotation between crew members to provide a distribution of workload and decrease the cumulative effects of the combined tasks.	3	Superintendent Employee	
		1	Superintendent	

Risk Factor	Recommended Controls	Control Priority*	Responsible Person	Status
Force: Lifting and lowering the hydrant shaft	<p>The length and weight of the shaft creates an awkward lift that should not be handled by one person. Ideally, this should be a mechanical lift only. Recommend investigating portable or truck mounted cranes / hoists to either:</p> <ol style="list-style-type: none"> <li>Replace the manual lift / lower entirely</li> <li>Assist with the lift / lower and allow two workers to perform an assisted lift / lower together.</li> </ol> 	1	Superintendent	
Force (push/pull): Valve Key Wrenches	<p>Example of crane</p> <p>Investigate automated tools and equipment capable of performing the initial force required to remove nuts and access water lines.</p> <p>Ensure any new tools do not create other risks associated with awkward postures when using. Trial period before purchase is recommended.</p>	1	Superintendent	
Overall risk factors	Provide education related to identified risk factors and methods of working to reduce risk e.g. neutral joint positions, leg position, reduction of twisting etc.	1	Superintendent	

**References:**

- Humanscale (1990) Body Measurement, Hand Grip, Human Strength and Seating Guide
- Eastman Kodak (1986), Ergonomic Design for People at Work, Volume 1 and 2
- WCB of BC, Worksheet A, Risk Identification and Worksheet B, Risk Assessment.
- NIOSH Lifting Guidelines (1991)
- Snook Push / Pull Guidelines
- The Advanced Ergonomic Manual (1994)

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