Musculoskeletal hazards and controls

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Musculoskeletal disorders (MSDs), such as chronic back pain or shoulder problems, often take time to develop. Forceful exertion, awkward positions, hand-arm and whole-body vibration, contact stress, and repetitive tasks can add up over time to produce an MSD.

This profile can help you identify and control MSD hazards in your job. We recommend that you add the best practices outlined here to your company’s health and safety program. The hazards in a particular job, however, may be different than the ones on this profile, so evaluate the risks of your specific work activities.

When implementing MSD controls, consider the following ergonomic principles:

1. **Use handling equipment and proper lifting and handling techniques.** The best way to prevent an MSD is to eliminate or reduce the frequency of lifting, carrying, pushing, and pulling. Use material-handling equipment such as carts, dollies, pallet jacks, or lift trucks. For proper lifting techniques, refer to the “Back Care” chapter in IHSA’s *Construction Health and Safety Manual* (M029).

2. **Don’t lift a load from the floor.** Lifting from the floor or from below standing knuckle height can put severe stress on your back and reduce your lifting ability. To avoid this, store objects above standing knuckle level and below standing shoulder level.

3. **Avoid working on the floor.** Constantly working on the floor can result in injuries to your back, hips, and knees because you usually have to kneel and bend forward. When possible, raise the work height by using a workbench.

4. **Avoid working above shoulder level.** High lifting or constantly reaching above your shoulders can be harmful. Most of the work is being done by the smaller muscles in your shoulders and arms instead of by the larger muscles in your back and legs. When your arms are raised, the muscles fatigue more quickly because there is less blood flow and there is a greater chance you could drop the object.

5. **Get help with large loads or split them into smaller loads.** Get help from a co-worker if a load is too heavy for you to handle on your own. If possible, divide the load into smaller loads. Making more trips with small loads puts less stress on your back than making fewer trips with large loads.

6. **Practise good housekeeping.** Pick up debris and garbage to prevent trips, slips, and falls. A clean worksite also allows you to get closer to your work and equipment.

7. **Conduct a Job Safety Analysis (JSA).** Actively assess the job tasks and implement MSD controls before starting work to avoid overexertion and awkward positions.

8. **Perform stretching and warm-up exercises before starting work.** This not only helps prevent MSDs but also promotes general good health. See IHSA’s *Before You Start Work Exercises Card* (V012).
## Exterior Installation

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<tr>
<th>Tasks</th>
<th>What can happen (Hazards/Risks)</th>
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| Preparing conduit          | ▶ Overexertion injuries to the back and shoulders from lifting and carrying large, heavy rolls of plastic conduit  
▶ Risk of lower-back injuries from awkward positions when installing plugs or switch boxes and tying conduit onto steel rebar  
▶ Overexertion injuries of the upper arms from repetitive tying  
▶ Slip and trip injuries from poor housekeeping or from steel reinforcement sagging or giving way because there are not enough ties or chairs | ▶ Plan ahead to minimize material handling tasks.  
▶ Use portable mechanical lifting equipment whenever you can, especially when loading or unloading heavy materials. Material handling equipment is available in many shapes and sizes and can be customized. Talk to your purchasing department or supervisor about getting the correct one for your needs.  
▶ Get help from a co-worker if a load is too much for you to handle on your own. Consider not only the weight of item but also the lifting location, your body position, and ergonomic principles.  
▶ Store heavy materials closer to the work location to reduce the distance you have to carry them.  
▶ Coordinate with other trades in the work area when carrying and placing conduits.  
▶ Remove clutter around the work area to make it easier to move materials.  
▶ Look into alternative tying methods that can reduce forceful exertion on the hand and repetitive hand twisting and bending while tying wires (e.g., use longer handles on nips to reduce the amount of effort needed to cut wires).  
▶ Use pre-tie wires or mechanical tying tools that can connect conduit to steel rebar without using the traditional manual tying method.  
▶ Reduce the tying tension applied to the wire.  
▶ Use spring-loaded pliers to reduce the force needed to operate them.  
▶ Work at an appropriate speed when tying wire.  
▶ When cutting and bending conduit, place materials on a workbench so that the back and the knees are not in static or awkward positions.  
▶ Use boots that have the following features:  
  ▪ Soles made of a durable, yet flexible material  
  ▪ Soles that are stiff enough to prevent rebar from digging into the bottoms, yet flexible enough walk comfortably (Steel or fibreglass shanks will provide added support.)  
  ▪ A semi-rigid arch support that helps create a better fit and allows for a more stable stance.  
  ▪ Insoles that fit properly. Buy insoles that match your boot size or go one size larger. You can use scissors to trim some insoles to custom fit your boot. The arch should fit the shape of your foot’s arch—not too high or too low. It should flex slightly when you move and not be so stiff that it’s uncomfortable. |
| Installing conduit – Ground and walls | ▶ Getting conduit tubes, plugs, or switch boxes  
▶ Installing plugs or switch boxes onto the construction forms  
▶ Rolling, cutting, and placing a bundle of conduit onto the construction forms  
▶ Punching out the conduit holes in the installed fixture box  
▶ Inserting conduit into the hole and running it to another box  
▶ Tying conduit to rebar with steel wire | ▶ Use portable mechanical lifting equipment whenever you can, especially when loading or unloading heavy materials. Material handling equipment is available in many shapes and sizes and can be customized. Talk to your purchasing department or supervisor about getting the correct one for your needs.  
▶ Get help from a co-worker if a load is too much for you to handle on your own. Consider not only the weight of item but also the lifting location, your body position, and ergonomic principles.  
▶ Store heavy materials closer to the work location to reduce the distance you have to carry them.  
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| Bending pipe               | ▶ Placing the conduit into the correct size of track on a Chicago Bender or choosing the correct size of hickey (manual pipe bender) | ▶ Use portable mechanical lifting equipment whenever you can, especially when loading or unloading heavy materials. Material handling equipment is available in many shapes and sizes and can be customized. Talk to your purchasing department or supervisor about getting the correct one for your needs.  
▶ Get help from a co-worker if a load is too much for you to handle on your own. Consider not only the weight of item but also the lifting location, your body position, and ergonomic principles.  
▶ Store heavy materials closer to the work location to reduce the distance you have to carry them.  
▶ Coordinate with other trades in the work area when carrying and placing conduits.  
▶ Remove clutter around the work area to make it easier to move materials.  
▶ Look into alternative tying methods that can reduce forceful exertion on the hand and repetitive hand twisting and bending while tying wires (e.g., use longer handles on nips to reduce the amount of effort needed to cut wires).  
▶ Use pre-tie wires or mechanical tying tools that can connect conduit to steel rebar without using the traditional manual tying method.  
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  ▪ A semi-rigid arch support that helps create a better fit and allows for a more stable stance.  
  ▪ Insoles that fit properly. Buy insoles that match your boot size or go one size larger. You can use scissors to trim some insoles to custom fit your boot. The arch should fit the shape of your foot’s arch—not too high or too low. It should flex slightly when you move and not be so stiff that it’s uncomfortable. |
## Interior Installation

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| **Installing strut channels** | ► Strain and sprain injuries of the shoulders from working above shoulder level  
► Strain and sprain injuries of the upper and lower back due to extending the back | ► Whenever possible, use a scissor lift or other power elevated work platform to install strut channels. An elevated platform allows you to work at optimal height, reducing stress on the neck and upper arms from awkward positions. Only use a ladder if it’s not possible or practical to use a work platform.  
► When handling large bundles of strut channels, split the load into smaller loads. This will reduce overexertion from lifting and carrying.  
► If a load cannot be split up, get help from a co-worker, or use a mechanical lifting device such as a cart or lift truck.  
► Store conduit materials closer to the work location to reduce the distance you have to carry them.  
► Use devices that position bundles of strut channels between knee level and shoulder level. This will give you easy access to the work materials and avoid awkward body positions when pulling and lifting the materials.  
► Keep cutting tools sharp to reduce the amount of force required to use them.  
► If you cut strut channels a lot, use a power saw.  
► When working above shoulder level, use a tool that has an extended arm or use extra-long screwdriver bits to extend your reach.  
► Move as close as you can to the work area and center yourself to reduce overreaching and bending at the waist.  
► Select the right tool for the job (e.g., use the correct saw for the type of material you’re cutting) |
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| **Installing strut channels**  
(continued) | | ▶ Choose tools that fit your hand comfortably. Whenever possible, use a lightweight tool. You will need less force to grip the tool, reducing stress on your shoulders and back.  
▶ Let your supervisor know if you need training on a new tool or work process.  
▶ Practise good housekeeping. Discard or pick up debris and scrap material to prevent repetitive bending and slips, trips, and falls. Keep pathways clear for carts, work platforms, wheelbarrows, and dollys to reduce forceful exertion when moving equipment.  
▶ Change work positions often. Working overhead or in cramped spaces forces the body into awkward positions. To relieve muscle tension and improve circulation, change your body position, alternate tasks, and stretch throughout the day.  
▶ Always use proper lifting techniques (i.e., lift materials with your legs, do not bend over or lift with your back, and keep the load close to your body).  
▶ Wear anti-vibration gloves to reduce the amount of vibration from powered hand tools going to your hands and arms. |
| **Installing conduit**  
▶ Assembling required material  
▶ Measuring and cutting conduit to the required length  
▶ Selecting the correct size of hickey (manual pipe bender)  
▶ Bending the conduit until the offset is reached  
▶ Sliding the conduit into place  
▶ Attaching a connector to the conduit  
▶ Punching out the holes in the fixture box and attaching the box to the connector  
▶ Bolting the connector to the strut clamp  
▶ Ensuring the conduit is straight  
▶ Attaching additional conduit with a coupling | ▶ Strain and sprain injuries of the shoulders from working above shoulder level  
▶ Strain and sprain injuries of the upper and lower back from awkward positions  
▶ Strain and sprain injuries of the ankles and feet from working at heights for long periods  
▶ Overexertion injuries from manual material handling of conduit | ▶ Whenever possible, use a scissor lift or other power elevated work platform to install conduit. An elevated platform allows you to work at optimal height, reducing stress on the neck and upper arms from awkward positions. Only use a ladder if it’s not possible or practical to use a work platform.  
▶ When handling large bundles of conduit, split the load into smaller loads to reduce overexertion from lifting and carrying.  
▶ If a load cannot be split up, get help from a co-worker or use a mechanical lifting device such as a cart or lift truck.  
▶ Work in a comfortable position. Use existing equipment to create a stable workbench that allows you to work while standing upright with your arms close to your sides. Make sure you have easy access to work materials. This will lessen the time spent untangling parts and reduce the forceful exertion required to pull tangled materials apart.  
▶ Use elbow pads to protect elbows from contact stress. They are very useful when working in cramped spaces or having to lean on elbows. Elbow pads should fit snugly but should not affect the circulation in your arm.  
▶ Use a shoulder pad when carrying heavy objects on your shoulder. This will reduce the strain on your shoulder by spreading the weight over a larger area.  
▶ Practise good housekeeping. Discard or pick up debris and scrap material to prevent repetitive bending and slips, trips, and falls. Keep pathways clear for carts, work platforms, wheelbarrows, and dollies to reduce forceful exertion when moving equipment. |
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<td><strong>Installing conduit</strong> (continued)</td>
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<td><strong>Pulling wire</strong></td>
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<td>▶ Assess the MSD hazards of the job tasks and implement controls before starting work to avoid overexertion and awkward positions. Cable pulling involves running a wire or cable through the conduit. This task can be a difficult and often the wires can become bunched up or get lost down the long conduits.</td>
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<tr>
<td>▶ Gathering needed material</td>
<td>▶ Strain and sprain injuries of the shoulders, wrists, and lower back from manually pulling and pushing electrical wires</td>
<td>▶ When handling wire spools:</td>
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<tr>
<td>▶ Running twine through the conduit</td>
<td>▶ Overexertion injuries from manual handling of wire spools</td>
<td>- Use mechanical lifting equipment such as specialized spool handling carts, lift trucks, or hoists to move work materials. Devices such as wire carriers can also reduce injuries from lifting and carrying.</td>
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<td>▶ Tying the twine to the end of the wire to be pulled</td>
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<td>- Use a two-person team lift to move large spools of wire such as the MC wire (e.g., 1000 feet of 12-3).</td>
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<td>▶ Communicating with the worker at the other end</td>
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<td>- Use proper lifting techniques if you cannot get help from a co-worker or use a material handling device.</td>
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<td>▶ Coating the taped end of the wires with soap</td>
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<td>▶ Use a mechanical wire puller whenever possible (e.g., a chugger/tugger, air-propelled cable puller, pusher, winch, or come-along). Learn to recognize when a mechanical wire puller is needed and how to use it.</td>
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<td>▶ Pushing the wire into the conduit while another worker pulls on the twine to draw the wire through the conduit</td>
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<td>▶ When pulling wire using a wire puller, pre-plan the job and communicate safe work practices for handling wire or operating the wire puller.</td>
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<td>▶ Cutting the twine when the wire is in place</td>
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<td>▶ When pulling wire by hand, consider the size of the wire, the number of wires, the diameter of the conduit, and the length of the conduit</td>
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<td>▶ To reduce forces when pulling wire by hand:</td>
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<td>- Lubricate the feeder end to reduce the pulling force. Synthetic, clear wax and polymer lubricants can be used with almost any type of electrical wire or cable.</td>
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<td>- Don’t cut and drag the wire. Feed the wire from a wire spool.</td>
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<td>- Use wire grips to hold the wire firmly in place. Match the size of the wire to the size of the wire pulling grips. Larger cables or wires require larger grips. The grips may include wire cutters and insulated handles to make them more functional.</td>
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<tr>
<td>Roughing in</td>
<td>► Installing fixture boxes, conduit, armor sheath cable, breaker panels, switches, plugs, and light fixtures.</td>
<td>► Assess the MSD hazards of the job tasks and implement controls before starting work to avoid overexertion and awkward positions.</td>
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<td>► Strain and sprain injuries of the shoulders from working above shoulder level</td>
<td>► Use mechanical lifting equipment whenever you can, especially when loading or unloading heavy materials.</td>
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<td></td>
<td>► Strain and sprain injuries of the upper and lower back from awkward positions</td>
<td>► Store heavy materials closer to the work location to reduce the distance you have to carry them.</td>
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<td>► Strain and sprain injuries of the ankles and feet from working at heights for long periods</td>
<td>► Use a height-adjustable mobile lift table to transport materials to the work area. These tables can also support material when you’re loading and unloading equipment.</td>
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<td>► Overexertion injuries from manual material handling of work materials</td>
<td>► Use a motorized pallet jack whenever possible, especially when moving material often or over long distances.</td>
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<td>► Use a cart to move tool boxes and work materials. When using carts or hand trucks:</td>
<td>► Use a cart instead of pulling it. Pulling causes more bone-on-bone compression in the lower back.</td>
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<td>- Select a model that has the type of wheels that are right for the ground conditions.</td>
<td>► Store heavy materials at least 20 inches from the ground. The optimal lifting height is between chest level and knee level.</td>
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<td>- Select a model with swivel wheels on the rear and fixed wheels on the front so it will be easier to push over long distances.</td>
<td>► Use a ramp made of either aluminum or wood when moving materials up stairs or over uneven walkways.</td>
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<td>- Maintain the wheels on handling equipment to reduce the force needed for pushing or pulling.</td>
<td>► Store materials in large containers to make them easier to move. Use a lift truck or crane to transport large quantities of materials such as cables, fixture boxes, conduit, breaker panels, switches, plugs, and light fixtures.</td>
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<td></td>
<td>- Make sure handles are located at the rear of the cart and at waist level.</td>
<td>► Use a shelving system that can store materials, tools, or equipment within easy reach and without having to bend or twist. If using a rack system, store items between knee and shoulder level whenever possible.</td>
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<td>- Make sure the height of the load on the cart does not block your view.</td>
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<td>- Keep loads balanced and under the manufacturers’ recommended weight limits.</td>
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<td>- Push a cart instead of pulling it. Pulling causes more bone-on-bone compression in the lower back.</td>
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<td>Roughing in (continued)</td>
<td>▶ Move as close as you can to the work area and center yourself to reduce overreaching or bending at the waist. ▶ Work in a comfortable position. Use existing equipment to create a stable workbench that allows you to work while standing upright with your arms close to your sides. ▶ When working above shoulder level, use a tool that has an extended arm or use extra-long screwdriver bits to extend your reach. ▶ Select the right tool for the job. ▶ Choose tools that fit your hand comfortably. Whenever possible, use a tool that requires less force (e.g., a lightweight tool or power tool). ▶ Let your supervisor know if you need training on a new tool or work process. ▶ Consider using a power elevated work platform when working at heights. It can reduce contact stress on the feet and ankles. ▶ Practise good housekeeping. Discard or pick up debris and scrap material to prevent repetitive bending and slips, trips, and falls. Keep pathways clear for carts, work platforms, wheelbarrows, and dollies to reduce forceful exertion when moving equipment. ▶ Wear anti-vibration gloves to reduce the amount of vibration from powered hand tools going to your hands and arms. ▶ Use elbow pads to protect elbows from contact stress. They are very useful when working in cramped spaces or having to lean on elbows. Elbow pads should fit snugly but should not affect the circulation in your arm. ▶ Use a shoulder pad when carrying heavy objects on your shoulder. This will reduce the strain on your shoulder by spreading the weight over a larger area. ▶ Install a hydraulic ladder rack to help with loading and unloading ladders from vehicles. ▶ When working at or near floor level, use a knee creeper to support your upper body and make it easier to move around. ▶ Use high-quality kneepads. (Note: kneepads distribute force over a larger area of the knee's surface, but don't reduce the force on the knee joint itself.) ▶ Kneepads with rollers allow you to move around easily by reducing the amount of friction between the kneepads and the floor. ▶ Sit on a work stool when the work is low to the ground.</td>
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| **Roughing in** (continued) | | ► Use a large, thick, soft mat to reduce contact stress when lying on the ground.  
► Rotate to other tasks when possible to give your muscles a break from repetitive movements.  
► Reduce the weight of a toolbox by removing any tools not needed for the job.  
► Use lightweight, cordless electrical tools to remove or install bolts and screws.  
► Take stretch breaks throughout the day to relieve discomfort and get the muscles moving.  
► Install a grasp bar on top of service vans to make it easier to enter the back of the van.  
► Install an extra step at the back of service vans to reduce the step distance between the ground and the bumper of the van.  
► Always use proper lifting techniques (i.e., lift materials with your legs, do not bend over or lift with your back, and keep the load close to your body).  
► When moving objects that are long or heavy, try using a walk-up/tilt-up technique or slide material to the work area. |
| **Chipping concrete** | ► Overexertion of wrists, arms, and shoulders from working with hand tools to remove concrete  
► Awkward positions (bending and kneeling) from cutting and chipping concrete below knee level and working in tight spaces | ► Use lightweight hand tools with low vibration. Look for tools with low kickback and torque reduction.  
► Hand tools should have the following features:  
   • A comfortable handle that provides a good grip (e.g., a rubber or spongy-type grip)  
   • A grip that is the correct size and is designed to be used by either hand  
   • A handle that lets you keep your wrist straight or in a neutral position when operating it.  
► When drilling overhead, consider attaching the drill gun to a telescopic arm extension. The arm will help support the weight of the heavy tool, reducing stress on the arms and shoulders.  
► Wear anti-vibration gloves to reduce the amount of vibration from powered hand tools going to your hands and arms. |
<p>| <strong>Working on ladders</strong> | ► Overexertion injuries of the lower back and shoulders from lifting and carrying heavy ladders | ► A ladder is neither designed nor intended to be used as a work platform. Before working from a ladder, make sure you have performed a risk assessment, and put controls in place to address the hazards. Follow the procedures outlined in IHSA’s “Ladder Use in Construction Guideline”. (<a href="http://ihsa.ca/pdfs/topics/ladders.pdf">ihsa.ca/pdfs/topics/ladders.pdf</a>) |</p>
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<td>Working on ladders (continued)</td>
<td>► Injuries of the feet and lower legs from standing for a long time on narrow ladder rungs</td>
<td>► Whenever possible, work from a scaffold or powered elevated work platform instead of a ladder. ► Use a cart or attach wheels to the ladder to help move it. (See example below.)</td>
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► When using a stepladder, follow these safe work practices:
- When climbing up or down, face the ladder and maintain three-point contact (have two hands and one foot OR two feet and one hand on the ladder at all times).
- Keep both feet on the ladder at all times when receiving, placing, or removing objects.
- Keep your centre of gravity at belt buckle (i.e., navel) level and between the side rails.
- Store tools or work materials above hip level so you don’t have to reach down below knee level to get them.
- Avoid reaching backwards when moving or reaching for objects.

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<td>▪ Store tools or work materials above hip level so you don’t have to reach down below knee level to get them.</td>
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<td>▪ Avoid reaching backwards when moving or reaching for objects.</td>
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<td>▪ Avoid rising up on your toes when reaching above your shoulders.</td>
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<td>▪ Avoid forceful or jerky pushing or pulling movements. They can throw you off balance.</td>
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<td>▪ Do not stand on the top cap of a stepladder or the step underneath it (i.e., no higher than the top step indicated by the manufacturer).</td>
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<td>▪ Use one hand to lift objects. Keep the other hand on the ladder to maintain three-point contact. Make sure the object is not too heavy (maximum 9 kg for males and 6 kg for females).</td>
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Don’t forget about other hazards at your workplace. For more information, visit ihsa.ca

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