Prevent Cranes & Hoisting Accidents by Implementing Rigging Safety Rules

With Canada in desperate need of new multi-family housing and infrastructure, major construction projects are springing up across the country. Regrettably, the surge in new construction has been accompanied by a spike in crane accidents and injuries, especially in B.C. highlighted by a crane collapse at a Kelowna residential tower construction site that killed 5 people and forced hundreds of others to evacuate. Just 2 days earlier, an 18-foot-tall crane tower came crashing down on a Toronto condo building.

Among the leading causes of crane accidents—and OHS violations—are faulty rigging practices and rigging equipment. "Rigging" refers to the fibre ropes, wire ropes, chains, slings, attachments, connecting fittings, and other associated components used in a hoisting operation to attach the load being lifted to the crane, hoist, or other device performing the lift. The good news is that you can prevent these problems by ensuring that workers who carry out rigging operations are aware of and follow best practices. Here are some best practices for rigging safety.

General Best Practices for Hoisting Operations

While rigging hazards vary depending on the equipment used, there are also fundamental dangers inherent to all hoisting

operations. So, let’s start with some general best practices.

1. Verify that the equipment is capable of safely handling the load being lifted, that is, that the weight of the load doesn’t exceed the equipment’s safe working load limit (WLL).
2. Determine the weight load by checking the shipping papers, design plans, catalogue data, manufacturer’s specifications, and erection plans.
3. If the weight load isn’t listed, have a competent worker calculate the weight of the load using a reliable formula.
4. Check the safe WLL of the hoisting device and rigging equipment which, under OHS laws, must be conspicuously and legibly marked on the equipment.
5. Don’t perform the hoisting operation if there’s any uncertainty or doubt about whether the load is within the safe WLL, unless and until that uncertainty and doubt is completely resolved.
6. Inspect all equipment before each use and regularly at least once a week.
7. Keep written records of all inspections listing the date and time of inspection, inspector’s name, item inspected, and inspection findings.
8. Don’t use any equipment that’s damaged or defective.
9. Apply the “rejection criteria” listed in the OHS regulations of your jurisdiction, if any, to determine whether a particular piece of rigging equipment is suitable for use.
10. Immediately take damaged and defective equipment out of service and either repair it or destroy it to ensure that nobody uses it in that condition.
11. Don’t use repaired equipment unless a competent person verifies that it’s suitable and safe to use.
12. Keep detailed records of maintenance, service, and repairs performed on hoisting equipment and keep those records at the work site in a location that’s easily

accessible to persons performing assessments of the equipment's history and condition for purposes of deciding whether the equipment is suitable and should remain in service.

13. Check for wind hazards considering both the wind conditions and size and shape of the load.
14. Don't carry out the hoisting operation if winds or other weather conditions pose a hazard to workers, the public, or property.
15. Ensure that the hoist line is plumb and don't carry out the operation if it's not.
16. Keep the equipment and load the minimum distance from overhead powerlines, which is generally:

Normal Phase-to-Phase Voltage Rating	**Minimum Distance**
750 volts to 150,000 volts	3 metres
150,001 volts to 250,000 volts	4.5 metres
Over 250,000 volts	6 metres

17. Keep workers and others out of the areas where loads are being hoisted so that they're clear of danger in case the materials or equipment fall.
18. Post warning signs to keep unauthorized people out of the area.
19. Implement and follow a proper signaling system for workers to use in communicating during hoisting operations.
20. Make a trial lift and trial lower to ensure everything is working in a safe manner before performing the actual lift or lowering operation.
21. Don't alter, modify, or repair rigging equipment unless you've been authorized and instructed to do so.
22. Create and implement a written rigging and hoisting equipment safety policy.
23. Be aware of the rigging requirements set out in the OHS regulations of your jurisdiction.

24. Implement a Compliance Game Plan for cranes, hoisting, and rigging safety equipment.

Best Practices for Rigging Ropes

The hoist rope is the most commonly used piece of rigging equipment. So, workers must be careful to inspect, use, and store it safely.

Fibre Rope Best Practices

Ropes made of natural and synthetic fibres are used for many rigging applications, such as slings for hoisting materials, handlines for lifting light loads and taglines for guiding and controlling loads.

- Ensure that the fibre you use is of the type, size, grade, and construction recommended by the manufacturer of the crane or hoist.
- Ensure that the fibre rope is compatible with the sheaves and drum of the crane or hoist.
- Inspect the entire length of fibre ropes regularly and before each use and determine their capacity and suitability based on the portion of rope showing the most deterioration—in other words, a rope should be deemed unsuitable only if a tiny portion is deteriorated and the rest of the rope is fine.
- Check for external wear and cuts, variations in the size and shape of strands, and discolouration.
- Assess the degree of elasticity or “life” remaining in the rope.
- Untwist the strands without kinking or distorting them.
- Check for indications of excessive internal wear including broken yarns, excessively loose strands and yarns, or accumulations of powdery dust.
- Verify that all splices are in good condition and all tucks are done up.

- Check for distortion in hardware.
- Be aware of and follow specific manufacturer recommended safe work loads of common fiber ropes.
- Unwind a new coil of fibre rope counterclockwise by laying it flat with the inside end closest to the floor and pulling the inside end up through the coil.
- After use, recoil the rope clockwise by looping the rope over your left arm until only about 15 feet remain starting about a foot from the top of the coil and wrapping the rope about 6 times around the loops while using your left hand to pull the bight back through the loops.
- Don’t try to remove kinks by pulling them straight but instead remove kinks carefully so as to avoid severely damaging the rope and reducing its strength.
- Bind and whip the ends of a fibre rope that’s been cut to keep the strands from untwisting.
- Store fibre ropes in a dry cool room with good air circulation, a temperature of 10-21°C (50-70°F) and humidity of 40-60%.
- Hang fibre ropes in loose coils on large diameter wooden pegs well above the floor.
- Protect fibre ropes from weather, dampness, and sunlight.
- Keep fibre ropes away from exhaust gases, chemical fumes, boilers, radiators, steam pipes, and other heat sources.
- Don’t use fibre ropes if they’re frozen.
- Allow fibre ropes to dry naturally before storing them.
- Allow a frozen rope to thaw completely before handling it to keep fibres from breaking.
- Wash dirty ropes in clean cool water and hang to dry.
- To avoid overloading a rope, apply the design factor of 5 for ropes used to hoist materials but not personnel and 10 for ropes used to hoist personnel and then making further allowances for the rope’s age and condition,

using the specific allowances provided for under the OHS regulations of your jurisdiction, if any.

- Don’t drag a rope along the ground, over rough or sharp edges, or across itself.
- Use softeners and lubricants to protect rope at the sharp comers and edges of a load.
- Use fibre ropes for straight line pulls only and avoid bends that may interfere with stress distribution in fibres.
- Use thimbles in fibre rope eyes to reduce wear and stress.
- Keep sling angles at more than 45° – lower angles may dramatically increase the load on each leg.
- Don’t use fibre rope near welding or flame cutting—sparks and molten metal may cut through the rope or set it on fire.
- Keep fibre rope away from high heat and strong sunlight.
- Don’t couple left-lay rope to right-lay.
- Workers who couple wire and fibre ropes should use metal thimbles in both eyes to keep the wire rope from cutting the fibre rope.
- Make sure that fibre rope used with tackle is the right size for the sheaves, that is, sheaves should have diameters at least 6 and preferably 10 times greater than the rope diameter.

[Wire Rope Best Practices]

Wire Rope Best Practices

Many of the above best practices for fibre ropes apply equally to ropes made of wire. Other best practices for wire ropes used for rigging:

- Ensure that the steel wire rope you use is of the type, size, grade, and construction recommended by the

manufacturer of the crane or hoist.

- Ensure that the steel wire rope is compatible with the sheaves and drum of the crane or hoist.
- Check steel wire rope across its entire length each day and regularly at least once a week.
- Thoroughly inspect wire rope that hasn’t been used for a month or longer before putting it back into service.
- Check for broken wires and assess any wire breaks found to determine if they increase the risk of further breaks or damage or otherwise make the wire rope unsuitable and unsafe to use using the “rejection criteria,” if any, listed in the OHS regulations of your jurisdiction. \
- Immediately remove broken wire ends by bending the broken ends back and forth with a pair of pliers so that the broken ends are left tucked between the strands.
- Check for worn and abraded wires and reduction in rope diameter.
- Immediately replace the rope if wear—which typically causes the outer wires to form a “D” shape—exceeds 1/3 of the diameter of the wires.
- Check wire rope for rust, pitting, and other forms of corrosion.
- Check wire rope for broken, jammed, crushed, or flattened strands.
- Check wire steel ropes for “constructional stretch.”
- Replace 6-strand ropes if they stretch more than 6 inches per 100 feet of rope, unless manufacturer’s instructions indicate that such stretch is suitable.
- Replace 8-strand ropes if they stretch more than 10 inches per 100 feet of rope, unless manufacturer’s instructions indicate that such stretch is suitable.
- Check wire rope for kinking, bird caging, fusing, and protrusion of the core or other damage resulting in distortion of the rope structure, or damage that could cause the rope to fail.
- Check wire rope for abnormal line whip and vibration.
- Don’t splice wire rope.

- Ensure that the rope end connections are securely fastened and kept with at least 3 full turns on the drum.
- Don’t use rotation-resistant wire rope as cable for boom hoist reeving and pendants, or where an inner wire or strand is damaged or broken.
- Lubricate the rope in accordance with the manufacturer’s instructions.
- Minimize shock loading.
- Start the load carefully, applying power smoothly and steadily to ensure there’s no slack in the rope.
- Use softeners to protect rope from corners and sharp edges.
- Don’t drag wire rope out from under loads or over obstacles or drop it from heights.
- Store unused rope in a clean, dry place.
- Don’t use wire rope that’s been cut, kinked, or crushed.
- Ensure that rope ends are properly seized.
- Use thimbles in eye fittings at all times.
- Guard against loops in slack lines from being pulled tight and kinking.
- If a loop forms, unfold it and don’t pull it out.
- Avoid reverse bends.
- Ensure that drums and sheaves are the right diameter for the rope being used.
- Ensure that sheaves are aligned and that fleet angle is correct.
- Immediately replace any sheaves that have deeply worn or scored grooves, cracked or broken rims, and worn or damaged bearings.
- Ensure that rope spools properly on the drum.
- Don’t wind more than the correct amount of rope on any drum.
- Don’t let the rope cross-wind.

[Best Practices for Slings]

Best Practices for Slings

Slings are structures used to attach a load to a crane, hoist, or lifting device. They may be made out of fibre rope or webbing, steel wire, chains, or other materials. Here are the best practices to ensure safe use of slings.

- Inspect slings before each use and regularly on a weekly basis.
- Check wire rope slings for kinking, wear, abrasion, broken wires, worn or cracked fittings, loose seizings and splices, crushing, flattening, and rust or corrosion.
- Keep wire rope slings well lubricated.
- Check fibre slings for external wear, cuts, elasticity, variations in the size and shape of strands, and discolouration.
- Mark slings with an identification number and their maximum capacity on a flat ferrule or permanently attached ring.
- Ensure you know and keep within the WLL of the particular sling.
- Mark the capacity of the sling for a vertical load or at an angle of 45°.
- Attach the sling securely to the load and crane, hoist, or other lifting device and position the hooks so they face outwards.
- Ensure the load is balanced and won’t tilt or fall.
- Center the sling load to prevent the load from shifting suddenly and causing a high impact load.
- Ensure that the load is free to be lifted.
- Keep fingers and toes clear when tensioning slings and landing loads.
- Position hooks of multi-leg slings facing outward from the load.

- Use corner pads to prevent the sling from being sharply bent, cut, pinched, or crushed.
- Use loops and thimbles to reduce wear, stress, and friction.
- Don’t allow slings to lie on the ground for long periods of time or on damp or wet surfaces, rusty steel, or near corrosive substances.
- Don’t drag slings out from underneath loads.
- Keep slings away from flame cutting and electric welding.
- Don’t use discarded hoist rope to make a sling.
- Don’t use single-leg wire rope slings with hand-spliced eyes because the load may spin, causing the rope to unlay and the splice to pull out.
- Use slings with Flemish spliced eyes.
- Don’t wrap a sling completely around a hook.
- Don’t bend the eye section of wire rope slings around corners.
- Ensure that slings and fittings fit freely and don’t force, hammer, or wedge them into position.
- Don’t join wire rope slings made from different lays of rope together because it may seriously affect the lifting capacity.
- Don’t use slings with knots.
- Don’t try to shorten or tie wire rope slings.
- Don’t shock load wire rope slings.
- Don’t slide the load along a rope.
- Ensure that the sling angle is always greater than 45° and preferably greater than 60°.
- When using multi-leg slings to lift loads in which one end is much heavier than the other don’t treat each leg as equally loaded, that is, don’t divide the total weight by the number of legs.
- Store slings on racks in a clean, dry place that’s protected from corrosion.

Best Practices for Shackles

Best Practices for Shackles

- Don’t use shackles for hoisting unless they’re made of forged alloy steel.
- Inspect the shackle eye and pin holes for stretching, elongation, and wear.
- Inspect the shackle body for bending, which indicates excessive side-loading.
- Inspect all shackle pins for distortion, surface blemishes, wear, and fractures.
- Ensure that all pins are straight and all screw pins are completely seated.
- Replace shackles that are bent, show excessive wear, that is, by more than 10% of the original diameter, or have an elongated eye or shackle pin holes.
- Be aware that shackle pins are designed and manufactured to match shackle capacity and thus shouldn’t be replaced with bolts.
- Don’t allow a shackle to be pulled or loaded at an angle because this may severely reduce its capacity and open up the legs.
- Don’t use screw pin shackles if the pin can roll under load and unscrew.
- Don’t use round pin shackles restrained only by a cotter pin for overhead lifting.
- Don’t force, hammer, or wedge shackles into position.
- Don’t exceed 120 degrees for the angle when using multiple leg slings.
- Use swivels instead of shackles in situations where the shackle may twist and become eccentrically loaded.

Best Practices for Rigging Hardware

Another key piece of rigging equipment are the hooks, shackles, eyebolts, and other hardware used to secure the load

to the crane. Here are best practices for safe use of rigging hardware.

Best Practices for Hooks

- Don’t use hooks unless they have a safety latch.
- Inspect the hook for cracks, bending, or distortion.
- Inspect the safety latch to ensure it’s operating properly.
- Ensure that the load is balanced in the hook.
- Don’t point-load, that is, place the bulk of a load onto a single point, a hook unless it’s designed and rated for such use.

[Best Practices for Eye Bolts]

Best Practices for Eye Bolts

- Attach only one sling leg to each eye bolt.
- If 2 or more rope eyes must be placed over a hook, install a shackle on the hook with the shackle pin resting in the hook and attach the rope eyes to the shackle to prevent the spread of the sling legs from opening up the hook and prevent the eyes from damaging each other.
- Ensure that eye or ring bolts used for hoisting are made of forged alloy steel.
- Inspect and clean the eye bolt threads and the hole checking for bends, cracks, or worn threads.
- Use bolts with shoulders or collars when performing angle loading operations—bolts without shoulders or collars may be okay to use for vertical lifting operations.
- Ensure that bolts are at right angles to hole, make contact with working surface and have property torqued nuts.

- Pack bolts with washers when necessary to ensure firm, uniform contact with the working surface.
- Ensure the tapped hole for a screw eye bolt (body bolts) has a minimum depth of one-and-a-half times the bolt diameter to ensure uniform grip.
- Apply loads to the plane of the eye and never in the other direction.
- Don’t insert the point of a hook in an eye bolt – use a shackle instead.
- Don’t reeve a sling through a pair of bolts – attach a separate sling to each bolt instead.
- Use only eye bolts that are stamped with their rated weight and not just their thread size.
- Orient the eye bolt in line with the slings—the eye bolt may bend if the load is applied sideways.
- Engage at least 90% of threads in a receiving hole when using shims or washers.
- Screw the eye bolt on all the way down and properly seat it.
- Install the shoulder at right angles to the axis of the hole and that the shoulder is in full contact with the surface of the object being lifted.
- Use a spreader bar with regular (non-shoulder) eye bolts to keep the lift angle at 90° to the horizontal.
- Use a swivel hoist ring for angled lifts.
- Don’t use bars, grips, or wrenches to tighten eye bolts.
- Don’t paint eye bolts because the paint may cover up flaws.
- Don’t shock load eye bolts.
- Don’t use a single eye bolt to lift a load that’s free to rotate.
- Don’t use a shackle that’s capable of lifting more than the eye bolt or the eye bolt may become overloaded.

[Best Practices for Turnbuckles]

Best Practices for Turnbuckles

- Don’t use turnbuckles unless they’re made with weldless alloy steel.
- Inspect turnbuckles frequently for cracks in end fittings (especially at the neck of the shank), deformed end fittings, deformed and bent rods and bodies, cracks and bends around the internally threaded portion, and signs of thread damage.
- Lock frames to end fittings when turnbuckles are exposed to vibration to prevent turning and loosening.
- Use wire or manufacturer-supplied lock nuts to prevent turning.
- When tightening a turnbuckle, don’t apply more torque than you would to a bolt of equal size.