

HEALTH & SAFETY ADVISORY

Tower Crane Maintenance and Inspection

Tower cranes are a common sight in the Ontario skyline, especially around the Toronto area. If used properly, they can make lifting and moving heavy materials around a construction site easier and safer. If used improperly, however, they can cause a lot of damage and serious injuries.

The Construction Projects regulation (O. Reg. 213/91) under Ontario's *Occupational Health and Safety Act* specifies legal requirements that must be followed when working with tower cranes. These include design, inspection, testing, and maintenance requirements, which must be completed by a competent person such as a professional engineer.

In 2018, a near-miss incident reinforced the need for proper maintenance and inspection procedures to be followed. A wire rope that controlled the operation of the trolley on a tower crane failed. The trolley was not hoisting a load at the time, so no injuries or property damage occurred. However, the consequences could have been quite different if the loss of control happened while the trolley was in operation.



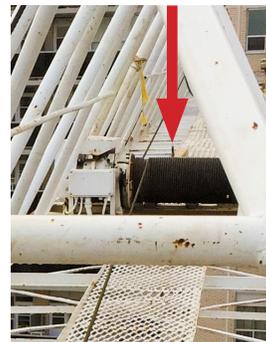
Tower Crane Trolley

Cause of Failure

A subsequent MOL investigation of this near-miss incident found that the electric motor, which operates the trolley, had an eye bolt protruding from its housing. The eye bolt was used to lift the electric motor during maintenance and should have been removed after the motor was installed.

As the trolley travelled along the boom of the tower crane and the cable worked its way along the drum, the eye bolt would make contact with the wire rope. Over time, this contact caused both parts to deteriorate.

Damaged parts such as these are often identified when proper inspections are carried out. However, this was not the case here. As the wire rope continued to wind around the drum of the trolley motor, it would bend across the eye bolt and begin to deflect or sag. Eventually, this abrasive action caused the wire rope strands to break and the wire rope to fail.



Location of Eye Bolt and Close-up of Deterioration Caused by Wire Rope Abrasion

Prevention

This incident could have been prevented if proper erection, maintenance, and inspection procedures had been followed, as specified in the Construction Projects regulation (213/91):

- A professional engineer (or a competent worker) is required to inspect a tower crane for defects after it is erected, before it is used, and at 12-month intervals after inspection. (s. 159)
- A competent worker is required to set up and assemble a crane as per the manufacturer's instructions and in a manner that does not endanger any person or property. (s. 154)
- A competent worker is required to inspect all mechanically-powered equipment (rated at more than 10 hp) to determine if it can handle the rated capacity and to identify any defects or hazardous conditions. (s. 94)

NOTE: During erection, maintenance, and inspection procedures, it is recommended that the competent worker follow the instructions in the tower crane operator's manual.

In addition, the owner of a crane or the employer at a project must ensure that the following legal requirements are met:

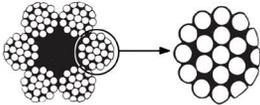
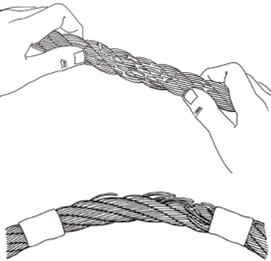
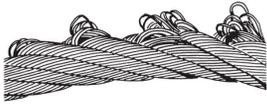
- All vehicles, machinery, tools, and equipment must be maintained in a condition that does not endanger a worker and must not be used if defective or hazardous. (s. 93)
- Modifications to a vehicle, machine, tool, or equipment must not result in a reduction of its safety factor. (s. 95)
- A crane must not include sections that are not designed for it or that are damaged. It must not include nuts, bolts, pins, or fastenings that are not specified by the manufacturer. (s. 154)

Based on these regulatory requirements, the eye bolt used to lift the motor housing during maintenance should have been removed because it created a hazardous condition, it reduced the safety factor of the wire rope, it was damaged, and it was not recommended by the manufacturer.

Wire Rope Inspection

Wire rope in continuous service should be checked daily during normal operation and inspected weekly. Rope that has not been used for a month should be inspected thoroughly. Look for the following warning signs (at sections showing the most deterioration) and take the recommended action.

Warning Sign	Recommended Action
Rust, lack of lubrication	Apply light, clean, warm oil and allow it to cool. NOTE: Do not use engine oil.
Corrosion	Develops inside rope, so difficult to see. Look for rust, discolouration, and pitting on outside. Consider replacing rope.
Frozen rope	Do not use. Avoid sudden loading of cold rope.

Warning Sign	Recommended Action
Excessive outside wear  Enlarged View of Single Strand Showing Reduction in Diameter	Reduce load capacity according to the amount of wear. Replace rope if outside diameter of wire is more than 1/3 worn away.
Broken wires 	Replace and destroy rope if you see one of the following: <ul style="list-style-type: none"> - 6 or more broken wires in one lay - 3 or more broken wires in one strand in one lay - 3 or more broken wires in one lay in standing ropes - 1 or more broken wires at an attached fitting.
Stretch	Replace rope if stretch exceeds 6 inches per 100 feet.
Gaps between strands	Replace rope.
Crushed, jammed, or flattened strands	Replace rope.
Bulges in rope	Replace rope, especially non-rotating types.
Heat damage, torch burns, or electric arc strikes	Replace rope.
Core protrusion 	Replace rope.
Kinks 	Replace rope. Destroy defective rope.
Bird-caging 	Replace rope. Destroy defective rope.

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