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RiskTopics

Rigging – wire rope slings

Zurich Resilience Solutions - Risk Engineering

This Risk Topic provides a general overview of the aspects related to the proper use and inspection of wire rope slings. The primary focus is pre-formed slings used for overhead lifting.

Introduction

Wire rope slings are the most common type of sling used for overhead lifting. One of the reasons is economy. They simply cost less than other types of slings of the same working load limit. There are some disadvantages to wire rope. They can corrode and may develop individual wire breaks if not properly cared for. While under load, a damaged or overloaded wire rope sling can fail quickly, without warning.

This Risk Topic aims to inform about key practices around wire rope sling selection, application, and care. It includes consideration of other rigging hardware, and protection of the loads being handled.

Discussion

All rigging equipment, including slings and other hardware, should be marked with its capacity. This is known as the working load limit, commonly abbreviated as "WLL." There is a safety factor applied that varies by product type, so the breaking point, also known as the ultimate strength, is several times greater than the WLL. No rigging equipment should ever be loaded in excess of its WLL. Even though a moderate overload may not cause an immediate failure, repeated overloads may cause imperceptible damage that may weaken the wire rope sling to where it may eventually fail at or even below its WLL.

Wire rope slings have advantages over the other three sling types used for overhead lifting – synthetic web, chain, and metal mesh slings. There are also some disadvantages.

Advantages of wire rope slings:

- Economical
- Fairly lightweight, flexible, and durable
- Damage is easily detectible
- Can be braided with additional slings for form higher capacity slings

Disadvantages of wire rope slings:

- Can scratch or mar painted or polished load surfaces without protection
- The wire rope "eyes" or end loops can be easily crushed unless protected
- Individual wires are easily broken from unprotected sharp edges
- Susceptible to heat damage from nearby cutting and welding
- Capacity tags are difficult to maintain
- May corrode over time unless protected from moisture

Wire rope slings for overhead lifting can be almost any size, and generally range from ¼-inch to three inches in diameter. The larger slings are less common due to their weight. Braiding of smaller slings, typically one inch in diameter or less is common to gain lifting capacity while maintaining flexibility.

Wire rope slings are formed by individual steel wire, drawn through dies to specified diameters. Various steel grades and capacities are available, with the most common type being Improved Plow Steel (IPS.) The individual wires are spiral wrapped to form strands of wire. The strands are wrapped around a core to form the rope. The core can be made of many materials, but for slings, the core is formed from steel wire strands

Guidance

Wire rope slings should only be handled while wearing heavy leather gloves or the equivalent. Broken wires can penetrate many other glove types, causing injury to hands.

All rigging equipment should be visually inspected immediately prior to each use. Wire rope slings usually accumulate the most damage in their eyes or end loops, due to sharp bending of the wire rope. Any part of the sling can be damaged from sharp edges or high heat. Wire rope slings cannot be repaired.

Almost all wire rope slings are pre-formed, with the eyes formed by a turned back end of the rope, secured by a compression fitting. Wire rope slings used for overhead lifting should never have the eyes formed by wire rope clips. Repeated loading and unloading of the rope could cause seating or compression of the strands, leading to loose clips that could slip and fail.

It is possible, and permissible, to form wire rope eyes by separating the strands at the end of a rope section, then looping the strands from opposite directions and weaving the strands back together to form a rope eye. The ends of the strands must have at least three full tucks into the rope body. Common names for this are "Flemish Eye" or "Molly Hogan." An advantage is that a skilled worker can create a sling in the field that is custom formed to length. Disadvantages are the sharp wire ends can be left protruding from the rope body. Generally, this type of sling is used only by pile drivers. Caution: Great care should be exercised in forming a Flemish Eye as the multiple loose wire ends can pose significant injury.

Consider using the following minimum criteria when evaluating whether a wire rope sling should be taken out of service:

- 10 or more broken wires in a length of 8 rope diameters
- 5 or more broken wires in a single strand in 8 rope diameters
- Rope crushing or flattening
- Bird caging – permanent distortion of strands, often without breaking wires
- Evidence of any melted wires, indicating heat damage
- A fairly sharp bend or kink, often called a dog leg – often caused by unprotected sharp load edges
- Severe abrasion
- Distorted rope structure
- End attachments damaged or worn
- 1/3 of diameter wear of outside wire
- Missing capacity tag

From the list above, only a missing capacity tag could be corrected. There are only two appropriate ways to take a sling out of service. The sling may be cut, or the sling should be tagged out of service. Dropping the sling in a trash without labeling it may allow others to retrieve and re-use the equipment.

Sling protection

Perhaps the most common causes of wire rope sling damage and failure is improper rigging methods. One cause is placing the sling over an unprotected sharp edge of a load. The edge should be protected by a softener. These can be simple job-made devices made from cut lengths of former synthetic web slings, to devices made for the purpose of corner protection. Devices can range from plastic "L" shaped devices with rounded corners to devices with magnets to temporarily attach to the load.

Most often, the sling eye suffers crushing which can result in broken wires and distorted rope structure. Rope manufacturers advise that rope should not be wrapped around any object smaller than 1.5 times the rope damage. Larger diameter anchors are much better. Commonly, a wire rope sling used in a choker configuration is used improperly without any hardware. When one rope eye is passed through the second, the second eye can be stressed and distorted by attaching it to the rope body that is too small. Easy corrective measures are available. A thimble on the second sling eye will prevent crushing. A slider on the sling with a large enough hook would be a good practice, as would a shackle with a body at least 1.5 times the rope diameter used with one eye on the shackle pin, and the shackle body used as a slider.

Conclusion

A key safety practice must be to confirm that all wire rope sling riggers are experienced in selecting the rigging materials, inspecting the equipment, and applying the rigging with sling types and arrangements to fit, control and retain the load. Because multiple rigging options are often available, care must be taken to select the best option and approach for achieve the intended objective.

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The Crosby Group, www.thecrosbygroup.com 800-772-1500

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