Crane & Hoist Safety Series:

Crane Rigging Basics

ACECO American CRANE & EQUIPMENT CORPORATION

Introduction

Cranes and hoists are simple but powerful tools used to lift oversized materials and equipment. Although they are widely used and safe when handled properly, operators should take care to follow basic safety principles to avoid injury. Even familiar tools can be dangerous if misused, especially when handling extremely heavy loads.

This guide is the first in our series of comprehensive safety tutorials dedicated to crane rigging. Here, we outline core operating principles for hitches and slings, including considerations specific to certain set-ups. After reviewing these handbooks, your employees will be well-prepared to tackle any crane rigging challenge in a safe and efficient manner.

Hitches and Slings: Common Types & Operating Principles

Any load lifted by crane gets secured using slings and hitches. Hitches are characterized by the manner in which the load attaches to the crane, including the number and type of attachment points.

Types of Slings and Hitches

The first principle of rigging safety involves choosing the correct type of sling and hitch for a given load. Each type of hitch has its own limitations and requirements that operators must follow during operation.

- **Vertical hitches.** A vertical hitch can safely lift at its maximum rated capacity under normal operating conditions, while any deviations from 90° decrease lifting capacity. Always verify that a vertical hitch has been secured at the load's center of gravity and ensure that the load remains balanced while being lifted. Never use a single sling and vertical hitch for very unbalanced or mobile loads.

- **Choker hitches.** Choker hitches secure around a load in such a way that they tighten as the load gets lifted from a single point. Users may incorporate multiple, non-overlapping slings to balance the load and double-wrap them when full contact with the load is necessary. Wrapping the sling in this way provides better load control but does not increase lifting capacity. Always calculate load reductions based on the angle of attachment. Avoid using choker hitches with loose bundles, which can slip out.

- **Basket hitches.** Basket hitches use one or more slings to cradle the load, but these wraps do not tighten on lifting the way that a choker hitch would. The legs may both attach to a single hook, or they may attach at either end of a spreader bar, depending on the load distribution. Basket hitches are ideal for controlling loads and preventing them from twisting, but they should only be used on loads that are easily balanced.

- **Bridle hitches.** Bridle hitches are a better choice for difficult-to-balance loads, connecting between two and four sling legs to the load. When securing a bridle hitch, adjust each leg separately to keep the load as level as possible, and secure all legs to a point directly above the center of gravity.

Similarly, it's important to choose the right sling material for a given job. Common sling materials include:

- **Alloy steel chain.** Alloyed steel is strong, durable, and abrasion-resistant, making it a popular choice for heavy loads and extreme operating conditions. When working with steel, it's important to verify that all attachments at least match the chain's rating to avoid failure at attachment points.

- **Wire rope.** Wire rope has similar properties to steel chain, including durability, strength, and abrasion resistance. Depending on the composition, wire rope is often chosen for its balance of strength and flexibility. Wire rope slings are often used in conjunction with rope clips, which should be used in accordance with manufacturer recommendations. Never use knots or wire clips to fabricate make-shift slings, and always ensure that clips are tightened evenly to the recommended torque before lifting.

- **Metal mesh.** Metal mesh slings are commonly used to carry hot or abrasive loads. Before use, examine the mesh carefully to verify the absence of damage from corrosion, abrasion, distortion, or broken wires. Although mesh features excellent strength and durability for lifts, any of these deformations can dramatically weaken the sling's capacity.

- **Fiber rope.** Fiber rope slings are more pliable and less likely to damage the load's surface, but they lack the raw strength and rugged durability of metal slings. As such, fiber rope slings are best used in temporary settings, such as for painting or construction jobs. In these applications, fiber rope slings provide an optimum balance of strength, convenience, and cost-effectiveness.

- **Synthetic web.** Synthetic web slings are woven from polymer-based yarns such as nylon or polyester, with the exact choice of fiber depending on the application and operating environment. Compared to metal mesh, synthetic mesh is often more economical while still offering beneficial and customizable resistance properties.

Safe Operating Practices for All Slings

Regardless of the hitch and sling type, some safety regulations apply to all crane rigging operations.

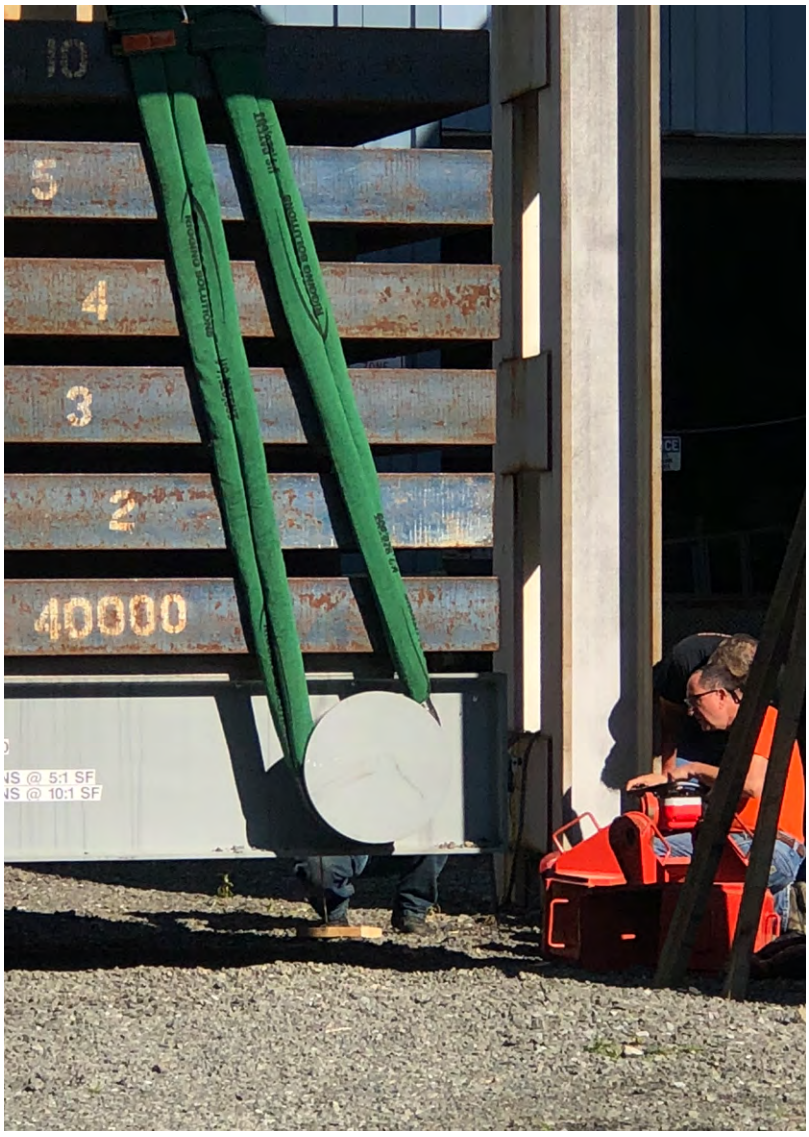
- Before lifting, ensure that every leg of the sling is securely attached to the load.
- Pad sharp edges to prevent loads from abrading slings, especially when working with synthetic web or fiber robes.
- Before lifting, ensure all employees are clear.
- Employees should remain clear of suspended loads until they've been lowered.
- When tightening slings, be careful to keep fingers out of the way.
- Never use a damaged sling or use a sling beyond its rated capacity.
- Never shorten a sling using makeshift fasteners.
- Never rest a load on a sling.
- Avoid riding any sling that has not undergone specific testing for carrying personnel.
- Maintain control of the load. Do not shock the load by changing its center of gravity during a lift or allowing it to free fall at any point.

Following these simple guidelines can prevent many of the most common crane rigging injuries.

Inspections

All slings and components must be inspected according to the manufacturer's recommendations. Typically, these guidelines stipulate quarterly inspections for heavy-use or severe-service conditions, or yearly inspections for standard conditions.

Slings and rigging components should also be inspected before each lift to identify any obvious defects or rips. Never attempt to patch a damaged sling. Instead, remove it from service and allow a qualified expert to either repair or replace it. Before lifting, employees should also verify working load based on the manufacturer's markings, which should remain permanently affixed and legible throughout the equipment's working life.



Determining Rated Capacity of Sling Attachments

Slings should never be used outside their rated capacity, so it's critical that operators know how to properly calculate working capacity based on sling-to-load angles. Vertical slings can be used at their full rated capacity, but all other hitches decrease capacity to some degree based on the sling-to-load angle. Any acute angle between the sling's legs and the load imparts tension onto the sling. This tension adds to the effective load, decreasing the working capacity.

To account for this loss in capacity, use a sling angle loss factor table to obtain the loss factor for a given angle, then multiply that factor by the maximum rated capacity. For slings with multiple legs, you can multiply the rated capacity by the number of legs first, then multiply the overall value by the loss factor. The new, smaller value is the maximum working capacity for this angle of attachment.

Another way to calculate the safe working capacity for non-vertical hitches is the actual load method, which uses inverse proportions to find the capacity for each leg of the sling:

- First, establish the vertical height of the hitch and the length of each sling leg. Divide the leg length by the vertical height to yield the proportional tension factor for each leg.
- Next, divide the total load weight by the number of legs to yield the rated vertical load per leg.
- Finally, multiply this value by the tension factor to get the actual load per leg.
- If the actual load exceeds the vertical load capacity, the sling is not strong enough to lift a load of this weight.

ACECO: Your Expert, Craftsman, & Partner

As a leading manufacturer of cranes, hoists, and other material handling equipment, American Crane and Equipment Corporation (ACECO) considers it our responsibility to promote safe and effective rigging practices. We hope that these guides can serve as valuable training materials for our clients and promote our commitment to safety throughout the industries we serve.

Here at American Crane, safety is our number one priority. While working in crane manufacturing can already pose multiple hazards, COVID-19 is now another hazard that is thrown into the mix every day. With proper management controls and personal protective equipment (PPE), our employees have been doing an excellent job to mitigate risks of contracting the virus. We are social distancing as much as possible and keeping employees in their own workstations. When social distancing is not practical, masks and proper sanitization have been our main focus.

Building cranes requires a lot of teamwork and communication from many different departments. We have also adapted to using virtual technology in our efforts to keep as many employees out of the shop and office as possible. Using these technologies gives our engineers the ability to see and hear our shop employees in real time while working from home to help lower the risk of contracting and spreading the virus.

For more information about our products and our people-focused vision, contact ACECO today.

We are your Expert, Craftsman & Partner.

Our goal is to make our customer's job easier. We provide turnkey material handling solutions for all types of industries; including nuclear, aerospace, energy, and general manufacturing. Our quality is built on depth of capabilities, with an integrated approach, in-house resources, and experience.

At American Crane & Equipment Corporation, we are uniquely positioned to provide our customers with a single source to provide the most highly engineered material handling solutions. This integrated approach includes project managers, engineers, complete manufacturing facilities and service technicians to help you with your material handling needs. Our company has a long-standing reputation as a leading supplier of quality equipment and engineering services to customers throughout the world.

At American Crane, **GRIT Matters**. We are passionate about delighting our customers and put **perseverance, heart** and **integrity** into everything we do.

Karen Norheim

President & COO

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