HOISTING AND RIGGING BEST PRACTICE
(May 1, 2023)

The purpose of this document is to provide information about hoisting and rigging practices during installation, inspection, servicing, and maintenance of conveyances which are covered in this document.

Introduction:
Rigging and hoisting is a fundamental part of conveyance installation and repair and requires knowledge of proper methods of rigging and hoisting. In the conveyance industry, the term rigging applies to all aspects of moving and hoisting heavy parts and machinery. Also included in rigging is the application of slings, chains, chokers, chain falls, hoists, etc. to the load in preparation for hoisting. Hoisting may be done by hand or with the use of power equipment, and good communication is essential to safe hoisting.

Section 1: General Requirements

1. Where available, you must use hoisting routes that minimize the exposure of employees to hoisted loads.
2. Always stay clear of the load in case it shifts unexpectedly. Always know the weight of the load you are hoisting, the capacity of your hoisting equipment, and the capacity of the structure you are rigging from.
3. Never stand directly under a load being hoisted.
4. When conducting hoisting operations, access to hoisting areas, especially hoistways and wellways, shall be restricted to elevator personnel involved in the lift. Warning signs shall be posted, and barricades put in place to restrict access to the area.
5. Before making the first hoist, and at the start of each day thereafter, rigging, overhead supports, and blocking shall be inspected. The hoist shall be inspected visually prior to each use.
6. Rigging equipment must have permanently affixed and legible identification markings as prescribed by the manufacturer that indicates the recommended safe working load. This safe working load shall not be exceeded. If the hoist or other equipment is not marked with the safe working load – do not use it.
7. No alterations to any hoisting and rigging equipment shall be made.
8. The overhead structure shall be padded where any choke or assembly is passed over steel.
9. Only properly made wire rope or nylon slings and chokers shall be used for rigging. Never use a homemade or altered sling or choker.
10. The use of two or more chain hoists for hoisting a single load is not permitted, unless any one of them will handle the entire load by itself.
11. Hooks without safety latches shall not be used.
12. When starting a lift, gradually take slack out of slings and make sure that no one's hands are in a position to be caught between the load and sling hook.
13. Clear communications are required. All verbal commands shall be repeated by the receiving party and reconfirmed by the directing party.
14. Hoisting equipment may require periodic recertification. At minimum, follow the manufacturers recommended recertification schedule. Do not use equipment that has passed the expiration date of the certification.

Section 2: Fiber Ropes

Natural, synthetic, and steel ropes are all used to hoist loads in the elevator industry. The type of rope chosen to hoist a particular load varies depending on the characteristics of the load and the environmental conditions on the jobsite. It's important to know the difference between rope types and

identify which are safe to use for hoisting. Your applications and your company's policies will determine the one you choose. In the conveyance industry, synthetic ropes are most common.

2.1: Manila Rope

1. Frozen manila rope should never be used for hoisting. The frozen fibers will break as they resist bending.
2. Rope deteriorates rapidly when not given the best of care. Manila rope shall be stored in a clean, dry location. Keep it off the floor. Rope absorbs moisture from concrete. Manila rope should be stored in an open sided crate or suspended from hooks or pegs, allowing maximum air circulation.
3. Good characteristics of manila rope:
    a. Hard but pliant
    b. Silvery or pearly luster
    c. Inner fibers bright & clean
    d. Uncut and unabraded outer & inner fibers

Figure 1 - Good *quality manila rope*

4. Poor characteristics of manila rope:
    a. Brown spots
    b. Black or dark spots
    c. Abrasion of fibers
    d. Cuts – Burns
    e. Dirt between inner fibers
    f. Loss of stretch

Figure 2 - *Poor quality manila rope*

2.2: Synthetic Rope

1. Synthetic fiber ropes are much stronger than the same size manila rope.
2. Synthetic fiber ropes are made from nylon, polypropylene, or polyester. Synthetic fiber ropes consist of individual threads and fibers that run the full length of the rope.
3. Synthetic fiber ropes are impervious to moisture and will not rot or mildew, even under the worst conditions of repeated wetting.
4. Some synthetics deteriorate slightly when exposed to sunlight. Polyester is completely resistant to sunlight, nylon shows some effects after long exposure, and polyethylene and polypropylene deteriorate rather rapidly under ultraviolet rays.
5. Nylon rope stretches under a load, which may be a disadvantage in some hoisting applications.
6. Poor characteristics of synthetic ropes:
    a. Abnormal wear
    b. Powder between strands
    c. Broken or cut fibers
    d. Variations in the size or roundness of strands
    e. Discoloration or rotting

2.3: Safe Working Load

1. Breaking strength is the tension at which a rope will tear under a load. Manufacturers determine breaking strength using testing devices. The safe working load of a rope is determined by dividing the breaking strength by a safety factor. Tables are published using a safety factor of 5. For example, a rope having a breaking strength of 5,000 lbs. would be rated as having a safe working load of 1,000 lbs. (5,000 ÷ 5). Below is a table of **safe working loads** for common fiber ropes taken from various manufacturers.

Diameter	Manila	Nylon	Polyester
3/8”	270 lbs	800 lbs	640 lbs
1/2"	450 lbs	1,420 lbs	1,080 lbs
5/8”	880 lbs	2,200 lbs	1.740 lbs
3/4"	1,080 lbs	3,000 lbs	2,700 lbs
7/8”	1,540 lbs	4,100 lbs	3,200 lbs
1”	1,800 lbs	5,400 lbs	4,300 lbs
1-1/8”	2,400 lbs	6,400 lbs	5,000 lbs
1-1/4”	2,700 lbs	7,900 lbs	6,200 lbs
1-1/2”	3,700 lbs	11,000 lbs	9,000 lbs

Safe working load for common fiber ropes

ALWAYS follow specific manufacturer recommended safe work loads of common fiber ropes.

2.4: Use and Inspection of Fiber Ropes

1. **Use:** Some good practices when using fiber rope:
    a. Keep rope dry, clean, and away from chemicals
    b. Never overload a rope
    c. Never use a frozen rope
    d. Never drag a rope on the ground. This will damage the outside surface of the rope
    e. Never allow the rope to bend over sharp edges
    f. Inspect rope often by twisting to expose the inside yarns

2. **Inspection:** Inspect the entire length of ropes before making the first hoist, and at the start of each day thereafter, to be certain they are safe for continued use. The following conditions may be cause for rejection:
    a. Broken yarns or strands
    b. Spots or sections of rot or mildew
    c. Abrasion and wear
    d. Cuts or burns
    e. Dirt between fibers
    f. Water soaking and freezing

2.5: Knots

The sharp bends necessary to form a knot weaken the fibers, particularly the fibers on the outside of the bend. Knots having smooth bends rather than sharp bends are less apt to weaken.
The weakening effect of common knots is shown in the table below. The table below indicates the percentage of strength left after the knot is tied, as taken from various manufacturers.

Weakening Effects of Knots	
Knot	**% Effective**
Straight Rope (no knots)	100%
Square Knot	45%
Bowline, Clove Hitch	60%
Timber Hitch, Round Turn, Two Half Hitches	65-70%
The above percentages of efficiency are approximate values as they have been proven to vary under various conditions of test and stress. However, they serve as somewhat of a standard to base your calculations upon and show how knots reduce the actual strain that may be safely applied to any rope.	

Section 3: Wire Rope

While wear is usually uniform throughout a length of wire rope, broken wires are generally found in one section. Before using wire rope for rigging or hoisting, always examine the entire length of the rope carefully.

3.1: Common causes of Wire Rope Failure:

a. Using wire rope of insufficient strength for the job.
b. Kinking. Never allow the wire rope to be kinked.
c. Improper lubrication, storage, and care.
d. Improper rigging.
e. Crushing on winch drum.
f. Using drums or sheaves of insufficient diameter.

3.2: Use and Inspection of Wire Ropes

1. **Use:** Some good practices when using wire rope:
   a. Keep rope dry, clean, and away from chemicals
   b. Never overload a rope
   c. Never drag a rope on the ground. This will damage the outside surface of the rope
   d. Never allow the rope to bend over sharp edges
   e. Inspect rope often

2. **Inspection:** Inspect the entire length of ropes before making the first hoist, and often thereafter, to be certain they are safe for continued use. The following conditions may be cause for rejection:
   a. Six or more randomly distributed broken wires in one lay
   b. Three or more broken wires in one strand in one lay
   c. Abrasion and wear
   d. Corroded or rusty end connectors
   e. Kinking or bird caging

Bird Caging *means the unraveling or spreading of the individual sections of wire rope. See the figure.*

Section 4: Chain Hoists

Generally, chain hoists are more durable and stronger than block and tackle. Chain hoists are available in capacities from 500 lbs to 25 tons. Always use a chain hoist of sufficient capacity for the load you intend to lift.

4.1: Chain Hoists General

a. All chain hoists shall be visually inspected for defects prior to first use, and daily when in use.
b. Verify hoist capacity plates are present.
c. Safety latches must be in place and working properly.
d. Check for hook damage. Inspect for cracks, nicks, gouges, twisting, deformation of the throat opening and wear on the saddle or load bearing point.
e. Load chain inspection. Check for nicks, gouges, deformation, flaws, heat damage, bent links, wear, stretch, corrosion, pitch elongation, and proper lubrication. Load chains shall be kept lubricated according to manufacturer's recommendations.
f. To check the hoist for its capability to handle the load, lift the load about one foot and lower again to the working level.

4.2: Chain Fall Driver

A hand-operated chain fall can be driven by a power-operated chain fall driver. The pull chain fits into the pockets of the chain driver and assists in operating the chain fall. Figure 3 shows a capstan hoist with a chain fall driver attachment.

Figure 3 – Chain fall driver attachment

Section 5: Power Hoists

There are two types of power hoists commonly used in the conveyance industry, the capstan hoist and the power winch.

5.1: Capstan Hoist

A capstan hoist is a power-driven metal drum or spool having wide flanges at each end. The drum surface is polished smooth. See figure 4.

Figure 4 – Capstan hoist

Figure 5 – Anchors installed on a shear

a. All capstan hoists and hoist ropes shall be visually inspected for defects prior to first use, and daily when in use.
b. Fasten the capstan securely to a beam or other building structural member so it cannot move. Anchors in concrete should be installed on a shear to prevent them from pulling out under load (see figure 5). Always follow manufacturer's instructions for mounting any hoist.
c. Wrap the rope on the drum so the hoisting part is closest to the driving machine with the free end farthest from the machine. Use three or four wraps to ensure a good grip between capstan and rope.
d. Capstans are intended for use with fiber rope and cannot be used with wire rope. Attempting to use wire rope on a capstan will result in accidents, injury, and damaged equipment.
e. Only use a constant pressure foot switch to operate the capstan hoist. Never use a toggle or on/off switch.

5.2: Power Winch

The power winch consists of an electric motor driving a drum through a gearbox. The drum is large enough to contain several hundred feet of wire rope and can be run in forward and reverse for hoisting and lowering. See figure 6A and 6B.

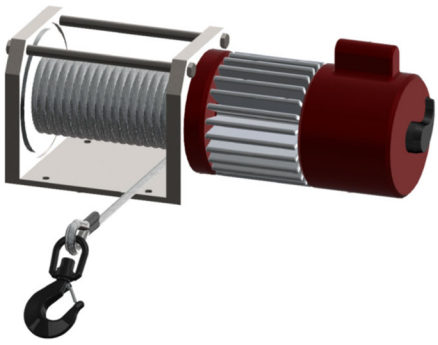


Figure 6A – Small capacity power hoist

Figure 6B – Large capacity power hoist

a. Fasten the hoist securely to a beam or other building structural member so it cannot move. Anchors in concrete should be installed on a shear to prevent them from pulling out under load. Always follow manufacturer's instructions for mounting any hoist.
b. All power hoists and hoist cables shall be visually inspected for defects prior to first use, and daily when in use.
c. Verify hoist capacity plates are present.
d. Hook safety latches must be in place and working properly.
e. Check for hook damage. Inspect for cracks, nicks, gouges, twisting, deformation of the throat opening and wear on the saddle or load bearing point.
f. To check the hoist for its capability to handle the load, lift the load about one foot and lower it again to the working level.

Section 6: Slings

Loads, headroom, and environmental conditions must all be considered carefully as part of the sling selection process. The sling that you choose must be capable of safely holding the load you intend to pick. It must also be made of the right material for your specific rigging task and jobsite conditions. There are four main types of sling materials: wire rope, chain, mesh, and synthetic. Some companies prohibit the use of certain slings. Your applications and your company's policies will determine the one you choose. In the conveyance industry, wire rope and synthetic slings are most common.

6.1: General

a. Chain slings should not be used when hoisting material.
b. Slings are to be used for hoisting equipment within their rated load.
c. An identification tag showing rated load shall be attached to the sling.
d. Slings shall be inspected by a designated person before each day's use, and damaged slings discarded.
e. Only approved slings of proper size, capacity, and configuration shall be used for rigging loads.
f. Slings should never be dragged on the floor or over an abrasive surface.
g. In a choker hitch, slings shall be long enough, so the choker fitting chokes on the sling and never on the other fitting.
h. Understand how sling angle affects the capacity of the sling. A sling angle of less than 30° should never be used.

6.2: Wire Rope Slings

Because of its strength, durability, abrasion resistance, ability to lift hot materials, and ability to conform to the shape of the loads on which it is used, wire rope is a commonly used sling material in the construction industry and other industries where heavy loads and rugged conditions exist.

1. **Use**
    a. Blocking or padding should be used when picking loads that place small radius bends on the wire rope sling.
    b. Kinks or bird caging, or the unraveling or spreading of the individual sections of wire rope, are signs of structural damage.
    c. Do not attempt to alter a wire rope sling. If a sling you are considering is not the proper length, find one that is. Altering a wire rope sling may cause damage to the sling or load.
    d. Always check the twists or lay of the sling for unraveling.

e. End fittings and other components should be inspected for any damage that could make the sling unsafe.
f. Store slings in an area where they will not be subjected to mechanical damage, corrosive action, moisture, extreme temperatures, or to kinking.

2. Inspection/Removal From Service

The following factors indicate that a wire rope sling needs to be removed from service:

a. Kinking, crushing, bird caging, unraveling, or any other damage resulting in damage to the rope structure.
b. Evidence of heat damage.
c. Fittings that are cracked, deformed, or worn to the extent that the strength of the sling is substantially affected.
d. Severe corrosion of the rope or fittings.
e. Other conditions, including visible damage, that cause doubt as to the continued use of the sling.

6.3: Synthetic Slings

Synthetic slings can be both web and round and are widely used for rigging in the conveyance industry where loads must be protected from damage. Their light weight, flexibility, and reduction of fatigue and strain on the rigger make them very popular.
Nylon and polyester slings should not be used in temperatures that exceed 180 °F (82 °C). Polypropylene should not be used in temperatures that exceed 200 °F (93 °C). Do not allow nylon and polyester slings to be used in contact with objects or at temperatures in excess of 194 °F (90 °C). Store slings in an area where they will not be subjected to mechanical, chemical, or ultraviolet damage.

1. Use

a. Each sling shall be permanently marked to show the rated loads for the types of hitches used, and the type of synthetic web material.
b. Slings shall not be shortened or lengthened by knotting or other methods.
c. Sharp corners in contact with the sling should be padded with material of sufficient strength to protect the sling.
d. Slings should not be pulled from under a load when the load is resting on the sling.
e. Slings should be stored in a cool dry, and dark place to prevent environmental damage.
f. Load applied to the hook should be centered in the base (bowl) of hook to prevent point loading on the hook.
g. Slings should be long enough so that the rated load is adequate when the angle of the legs is taken into consideration.

2. Inspection/Removal from Service

A synthetic web sling shall be removed from service if any of the following conditions are present:

a. Missing or illegible sling identification.
b. Acid or caustic burns.
c. Melting or charring of any part of the sling.
d. Holes, tears, cuts, or snags.

e. Broken or worn stitching in load-bearing splices.
f. Excessive abrasive wear.
g. Knots in any part of the sling.
h. Discoloration and brittle or stiff areas on any part of the sling, which may mean chemical or ultraviolet/ sunlight damage.
i. Fittings that are pitted, corroded, cracked, bent, twisted, gouged, or broken.
j. Other conditions, including visible damage, that cause doubt as to the continued use of the sling.

NOTE: All Web Slings have a warning feature. The red core yarns become exposed when the sling surface is cut or worn through the woven face yarns. When red yarns are visible, the sling should be tagged defective and removed from service immediately. See figure 7A and 7B.

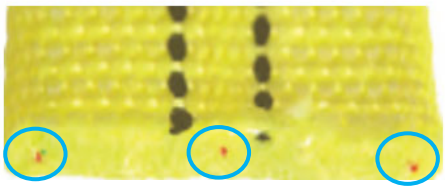


Figure 7A

Figure 7B

See OSHA 29CFR 1910.184 and ASME B30.9 for more information regarding slings.

Section 7: Hoisting Supports

Before hoisting any load, you will need an anchorage to support your hoisting equipment. In the conveyance industry, this will usually be a hoisting beam or gantry, and a beam clamp. Know the capacity of your anchorage before hoisting.

7.1: Hoisting Beam

The hoisting beam rests on and is supported by the building structure. Before using any hoisting beam, ensure that it is securely fastened and that it cannot shift when a load is applied. The larger the beam, the heavier the load it will maintain safely.

7.2: Beam Clamps

A beam clamp is an arrangement of formed steel plates secured together by bolts, which are fastened to the lower flange of an “I” beam and used to suspend hoisting equipment.

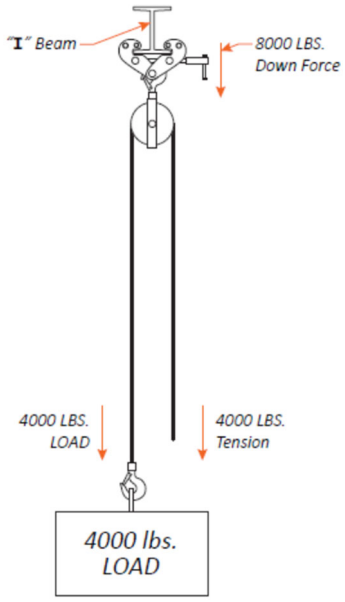
When using beam clamps which are supported by the lower flange of the hoisting beam, consider the following:

- How much of a load is already being carried by the beam?
- The capacity of the lower flange of the beam.

Never load the lower flange to more than 50% of the load which could be handled by the full capacity of the beam.

a. A beam clamp used for rigging shall be engineered to properly support the expected load. Never load a beam clamp beyond its rated capacity.
b. Do not use a choker through the eye of the beam clamp while hoisting.
c. Beam clamps shall be properly sized for the beam to which it is attached.
d. Use only case-hardened bolts with lock nuts or nuts with lock washers for the beam clamp assembly.

Before using an overhead beam for hoisting, be aware of the stresses imposed. A winch working from a point lower than the hoisting beam exerts a downward pull on the beam. If the hoist rope passes over a single sheave making a direct pick, the downward force on the beam is double the weight of the load being hoisted. If a 4,000 lbs. machine is hoisted by a direct pick, the down force on the beam (neglecting friction) is 8,000 lbs.



Section 8: Training

Training shall be provided so that all employees possess the understanding, knowledge and skills necessary for the safe performance of the duties required for rigging and hoisting.
Employees who perform crane picks or other hoisting activities with a crane must be trained as a Qualified Rigger/Signaler.

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(May 1, 2023)

Rigging at Level 1 vs. Rigging at Level 2

Some jurisdictions require that any individual involved in rigging work hold an active certification as a Rigger Level 1 (follows directions to set up and conduct rigging activities) or Rigger Level 2 (engineers plans for rigging activities). Check the requirements within your local jurisdiction before hoisting.

Through the Alliance between OSHA's 10 Regional Offices and the Elevator Contractors of America (ECA), Elevator Industry Work Preservation Fund (EIWPF), International Union of Elevator Constructors (IUEC), National Association of Elevator Contractors (NAEC), National Elevator Industry Educational Program (NEIEP), and National Elevator Industry Inc. (NEII), collectively known as The Elevator Industry Safety Partners (EISP), the EISP developed this Industry Specific Best Practice for informational purposes only. It does not necessarily reflect the official views of OSHA or the U.S. Department of Labor. May 2023