Basic Rigging Principles, Part 3: Rigging Equipment

Rigging equipment failure can cause loads to fall, injuring people and damaging property. By knowing the qualities and characteristics of slings, connectors and adjusters, you can help ensure that equipment and rigging jobs are safe.

Types of Equipment
The general categories of rigging equipment are:

- **Slings** that we loop or form around the load to form hitches
- **Connectors** that link pieces of rigging equipment
- **Adjusters** are devices we use to lengthen or shorten the legs of the rig to place the load hook directly above the load's center of gravity
- **Weight distributors** distribute the weight of the load to more than one point

Slings
Slings may be made of wire rope, chain, metal mesh, or synthetic fiber rope or webbing. Natural fiber rope is generally an UNSAFE material for load-bearing slings but may be used for taglines. **All slings must have a capacity tag permanently attached to them.**

Wire Rope Slings
Wire rope slings are made up of steel strands wrapped or braided around a wire rope core. The helix or spiral of the wires and strands in a rope is called the lay. Wire rope slings are common in the construction, oil and gas and manufacturing industries due to their ability to lift heavy loads and withstand tough conditions.

Advantages	Disadvantages
Lighter in weight than chains	Hard to inspect internal strands
High strength and flexibility	Not repairable
Braids are resistant to kinking	Susceptible to corrosion
Variety of designs for different benefits	

When using wire rope slings never join wire rope slings with different lays or shorten wire rope slings; doing so can seriously affect the slings' lifting capacities. Be aware that the rotation of a load on a single hitch can undo the wire rope strands and weaken the rope.

Remove wire rope slings from service if you find damage, wear and defects. This includes:

- 10 randomly distributed broken wires in 1 rope lay
- 5 broken wires in 1 strand in 1 rope lay
- Kinking, crushing or distortion
- Expanded strands
- Heat and corrosion damage

Chain Slings
Chain slings must be constructed of alloy steel. Chain slings are typically in areas with harsh conditions, such as foundries, steel mills and heavy machine shops. Remove the chain sling from service if you find any links that have cracks or do not hinge freely with adjacent links.

Advantages	Disadvantages
More resistant to harsh conditions than wire ropes or synthetics	Heavier than wire rope and synthetics
May be repaired, tested and certified if damaged	Less able to stretch than wire rope or synthetics
Damage can be more obvious than other sling types	Can damage or crush sensitive, delicate or finished loads
Turn corners without significant wear/damage	

Metal Mesh Slings

Metal mesh slings are made from carbon steel, stainless steel or alloy steel. They may be coated or impregnated with material that has elastic qualities. Metal mesh slings are useful for loads that are hot, have an irregular shape or have sharp edges, such as in metalworking.

Advantages	Disadvantages
Flexible	Even one broken wire makes them unsafe
Resistant to heat (untreated metal)	Not repairable
Resistant to corrosion	Susceptible to crushing damage

When you inspect metal mesh slings, make sure they move or articulate freely and that any handles are free of defects or damage.

Synthetic Fiber or Webbing Slings

Synthetic fiber or webbing slings are made of nylon or polyester. They may have 1 or 2 layers of material. Almost all industries use synthetic slings because they are effective for lifting oddly shaped loads and cylindrical materials.

Advantages	Disadvantages
Lighter than other types of slings	Not as durable as other types of slings
Material soft and flexible	Easily cut/damaged by abrasive and sharp edges
Can protect delicate loads from scratching and crushing	May be damaged/melted by prolonged exposure to direct sunlight
Variety of designs for different benefits	Require more frequent inspection in harsh conditions
	Not repairable

Remove synthetic slings from service if you find broken stitches, snags, discoloration, punctures, cuts or damage. Do not use attachments with sharp edges or projections on synthetic slings.

Hitches

Rigged slings are called hitches. We categorize hitches based on the type of sling we use and how we rig it to the load. **Endless sling hitches** are continuous loops with no connectors. **Single-leg sling hitches** are slings with eyes or loops at each end. The eyes often contain an insert called a thimble to help retain the shape of the eye.

Hitch Type	Endless	Single-Leg
Vertical	✓	✓
Basket	✓	✓
Double basket hitches	✓	✓
Double-wrap basket	✓	✓
Choker hitch	✓	✓
Doubled choker		✓
Double-wrap choker		✓
Multiple-leg (bridle)		✓

You can use both endless and single-leg slings to create a **vertical hitch**. In both cases, we lift the load using a single sling from the center of gravity on the top of the load.

When you are using a wire rope sling, use more than one to prevent or limit twisting motions that unwind the cables and weaken the rope. Do not use vertical hitches to lift loose materials or long or unbalanced loads.

You may create **basket hitches** with endless or single-leg slings by passing the sling under the load and up its sides to create a cradle for it. Use **double basket hitches** (basket hitches in pairs) for added stability, especially with wide loads. **Double-wrap basket hitches** loop completely around the load before going up its sides. This allows them to grip the load and keep the sling from slipping.
To form a **choker hitch**, pass one end of the sling around the load and then couple it to the upright portion of the load. For endless slings, couple it by using the looped end, and for single-leg slings, couple it by using a free-running shackle or sliding hook. A **doubled choker hitch** provides more contact area and may help riggers turn loads. Place both sling eyes on top of the load, pointing in the direction that is opposite to the direction of the turn. A **double-wrap choker hitch** wraps the sling once around the load before it couples to the upright portion of the sling for added grip and to prevent slipping.

Multiple-leg hitches, also called bridle hitches, include slings that have two or more legs. Each leg usually attaches to an eye on the load with a shackle. Typically, the legs are gathered at a ring that attaches to the load hook of the lifting device. Competent riggers usually determine what type of bridle hitch they need in advance and assemble it before the job. Riggers use adjusters (turnbuckles) to position the load hook directly above a load's center of gravity.

Connectors
Connectors are hooks, eye bolts and shackles that riggers use to link pieces of rigging equipment.

You may connect **hooks** to shackles, eye bolts or directly to the eye of a sling. Make sure hooks have safety latches, wherever possible, to keep loads on hooks. Check hooks for spreading and bending, cracking (often inside the shank) and safety latch operation.

Shackles are U-shaped connectors with pins that riggers use to couple slings to hooks, slings to eyes, and hooks to eyes. Riggers may also use shackles to make a choker hitch with a single-leg sling. A screw-pin shackle has a body and a pin. The body collects the ends of slings. Place the pin on the crane hook or through the eye of an eye bolt. **Never substitute a bolt for a shackle pin.** Substituting a bolt for a shackle pin is dangerous because ordinary bolts are much weaker than a hardened steel shackle pin. Inspect the body of the shackle for bending, cracking and damaged threads. Check the pin to make sure it is straight, and its threads are free of stretching or stripping.

Eye bolts are threaded connectors on loads where riggers attach slings. Straight-shank eye bolts are for straight lifts only. If an angled load is applied to a straight-shank eye bolt, the shank will bend or break. Shouldered eye bolts are designed to be stronger when weight is applied at angles ≥ 45°.

Adjusters

Turnbuckle adjusters are threaded bodies with screws at each end. Turning the screws will lengthen or shorten the turnbuckle. Turnbuckles are ideal for small adjustments. Inspect turnbuckles for bending, spreading and cracking and make sure the screw threads are in good condition.

Selection

Generally, a competent rigger will choose rigging equipment that can handle a capacity of at least 1.5 to 2 times the weight of the load. The competent rigger will also consider the material with which the equipment is made to evaluate its advantages and disadvantages given the job and its environment.

Hitch configuration influences the tension on rigging equipment:

- More sling legs reduces the amount of tension on any one leg
- Tension may be concentrated at sharp bends and cinch points.
- The more a sling's angle departs from being vertical, the more tension