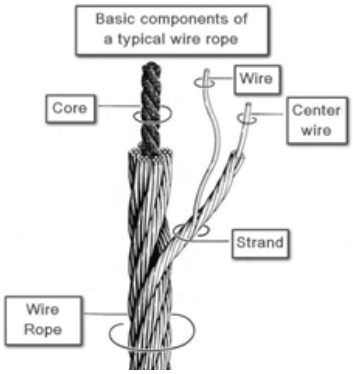
Product Information Report
Wire Rope



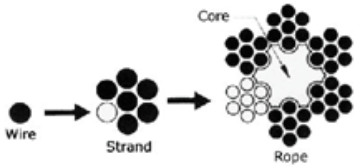
Overview

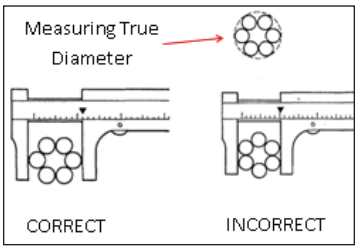
Wire rope is a strong, flexible steel cord that is typically used for hoisting, towing and anchoring heavy loads.

There are many different kinds of wire rope designed for many applications. The two most opposing characteristics are flexibility and resistance to abrasion.

For example, comparing two same-diameter cables, one may be constructed with fewer larger individual diameter wires which will provide better abrasion resistance but will have reduced flexibility. Conversely, the other may be constructed with a larger number of smaller diameter individual wires which will reduce the abrasion resistance but provide increased flexibility and resistance to kinking.

Wire Rope Components





Wire

Wire rope is supplied in different grades, which describe its strength and life. The grade of wire rope cannot be determined by feel or appearance.

- **IPS** Improved Plow Steel
- **EIPS** Extra Improved Plow Steel also referred to as XIPS, XIP or EIP (most common supplied grade)
- **EEIPS** Extra Extra Improved Plow Steel
- **S/S** Stainless Steel Grades 302/304 and 316

Ropes can be specified as bright, galvanized, stainless, or plastic-coated for corrosion protection, cosmetic appearance and cushioning of the cable strands.

Most running ropes are supplied bright finish unless a corrosive or harsh environment is present. Standing ropes are usually galvanized. Stainless steel is commonly used in marine environments.

The typical design factor for wire rope used as a sling is 5:1. The design factor is the ratio between the ultimate strength of the rope and the recommended working load limit (WLL).

Strands

The design arrangement of a strand is called the construction. The individual wires may all be the same size or a mixture of sizes.

- **Ordinary** All wires are the same size
- **Seale** Larger diameter wires are used on the outside of the strand to resist abrasion and smaller wires are inside to provide flexibility
- **Warrington** Alternate wires are large and small to combine abrasion and fatigue resistance

Core

Three basic core types provide support for the strands:

- **FC** Fiber Core Rope has less strength than steel core rope but provides greater flexibility. The fiber acts as an oil reservoir to reduce friction.
- **WSC** Wire Strand Core Rope has a single wire strand as its core. This resists more heat and provides higher strength, but is less flexible than fiber core and is mostly used for smaller diameter, static or standing ropes.
- **IWRC** Independent Wire Rope Core is a separate wire rope over which the main strands of the rope are laid. This strengthens the cable, provides resistance to crushing and resistance to heat.

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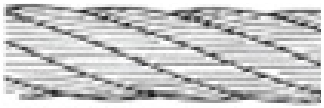
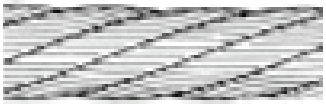
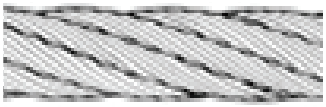
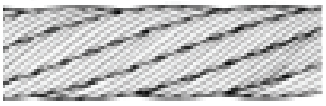
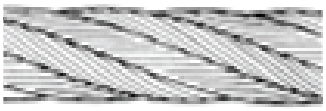
Lay of Wire Rope

Lay refers to the direction that the strands are laid in a rope and the direction the individual wires are laid within the strand. Depending on how the rope is to be used, the wires and the strands may be laid in the same direction or in opposite directions. Regular lay ropes have greater lateral stability than lang lay, and six-strand wire ropes have greater lateral stability than eight-strand ropes.

Wire rope is supplied in right regular lay unless otherwise specified. Non-rotating or rotation-resistant designs specify multiple layers of strands wound in alternating directions.

	Definition	Characteristics
 Right Regular Lay	**RRL** – The strands are laid to the right and the wires within the strands are laid to the left.	**Regular Lay Rope** is less likely to kink and untwist, and is more crush resistant than lang lay.
 Left Regular Lay	**LRL** – The strands are laid to the left and the wires within the strands are laid to the right.	**Lang Lay Rope** is more flexible, abrasion resistant, and fatigue resistant than regular lay, but may have a tendency to kink and untwist with bending over smaller diameters.
 Right Lang Lay	**RLL** – Both the strands and the wires in the strand are laid to the right.	**Right Lay Rope** may have a tendency to loosen couplers whereas the left rotation of a left lay rope tightens couplings.
 Left Lang Lay	**LLL** – Both the strands and the wires in the strand are laid to the left.	**Left Lay Rope** has greatest usage in oil fields and tube lines.
 Reverse Alternate Lay	**RAL** – All strands are laid to the right and the individual wires within the strands alternate direction from one strand to the other.	**Regular Alternate Lay** combines the best features of regular and lang lay for boom hoists or winch lines.

Class

Wire rope class is expressed in the number of strands by the number of wires per strand. Popular construction is grouped into classes. For example: 6 x 25 class indicates the wire rope consists of 6 strands, which in turn have 25 individual wires. Within a class, the number of wires in the strand is a nominal range. Thus, for the same class the actual number of wires may vary within a range.

The most common classes for standard cable are:

1x7 Strand – Non-Flexible
Small diameters of this configuration are used as fishing leaders and line. Larger diameters are used for guy wire and messenger strand applications.

1x19 Strand – Non-Flexible
Typically used for push-pull and guying applications. Also used for standing rigging on sailboats.

6x19 is the most popular and versatile cable class, combining maximum abrasion resistance and flexibility.
6x37 is more flexible and does not have as much wear resistance – suitable for cranes.

6x19 Class Wire Rope – Flexible
Used extensively in the logging and oil industries and for lifting equipment in the construction industry.

6x37 Class Wire Rope – Very Flexible
A true working wire rope. This type of construction finds extensive use in heavy-duty hoisting equipment such as cranes. Also used in power shovels, skidders and excavators as well as logging and oil field applications.

Aircraft cable refers to a general construction and does not indicate the cable is to be used in aircraft applications or for lifting and suspended loads. It is ideal for smaller diameters which require flexibility – for use with pulleys, sheaves and winches.

7x7 Aircraft Grade Cable – Flexible
For use where extreme flexibility is not necessary. Used in aircaft and automotive controls. Performs well in a wide range of mechanical applications.

7x19 Aircraft Grade Cable – Very Flexible
Used in aircraft controls, running rigging on sailboats, strength-training equipment and garage doors. Used when flexibility and fatigue resistance are essential.

Common Terminations

The ends of wire rope are often turned back and secured to form a loop and prevent fraying. Termination efficiencies vary depending on the type of termination. It is good practice to use a thimble to preserve the natural shape of the loop and protect the cable from pinching and abrading.

Compression Sleeves and Thimbles

A mechanical or hydraulic crimper is used to compress or deform the fitting or sleeve creating a permanent connection. With nylon coated rope, the nylon should be peeled back and the sleeve crimped swaged on the bare wire. Terminating fiber core rope with swaged fittings is not recommended.

The rated breaking strength of a wire rope can be maintained if the end is terminated with a properly crimped compression sleeve.

Flemish or Swaged Eye Splice

Steel sleeves are rugged and withstand a lot of abuse as they secure the strand ends around the body. This is the preferred method of termination for the construction industry and most industrial sling applications.

The rated breaking strength of the wire rope will be decreased to 70% of the original breaking strength.

Wedge Sockets

A wedge socket end fitting is preferred for use in applications where the fitting end is frequently changed. An example of this would be high-wear regions like the ends of draglines. The rope end may be trimmed, requiring the termination hardware to be removed and reapplied.

Single Grip, Single Saddle Wire Rope Clamp (One Single Saddle with U-Bolt)

Double Grip, Double Saddle Wire Rope Clamp (Two Separate Saddles with U-Bolt)

Wire Rope Lubrication

Over time, the original lubrication will be lost and the rope will have to be lubricated to extend its service life. There are two types of wire rope lubricants: penetrating and coating. A recommended approach is to use both types of lubricants. A penetrant will help get the lubrication down in the center of the core and a coating will help seal and protect the outer surface.

- Petrolatum compounds provide good corrosion and water resistance and are clear, which allows better visual inspection. These are better for low temperatures.
- Asphalt-base products adhere well for extended periods of time but can become brittle in colder temperatures.
- Various greases with semifluid consistency are used for lubrication because they can both coat and penetrate to some degree.
- Petroleum and vegetable-based oils penetrate best to provide inner resistance to wear and corrosion.
- Hardened lubricants on the surface should be brushed off with solvent and air, allowed to dry, and immediately re-lubricated to prevent rusting.
- Look for greases with high four-ball test ratings of 50 and above.

Wire Rope Clips

Wire rope clips are used to make eyes in wire rope. The U-shaped part of the clip with the threaded ends is called the U-bolt, the other piece is called the saddle. The size of the wire rope on which the saddle is intended to be used is stamped on the saddle. There are simple formulas that determine how may clips are required and the spacing between the clips, based on the size of the wire rope.

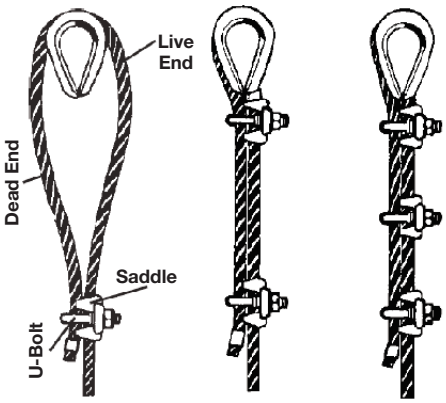
3 times the wire rope diameter + 1 = number of clips

6 times the wire rope diameter = the spacing between clips

Wire Rope Clip Cautions

- Never use malleable iron (agricultural grade) wire rope clips to make slings. Only use forged steel wire rope clips.
- Always place the U-bolt on the dead end of the wire rope. Always put the saddle on the live end of the wire rope. Rule of thumb: Never saddle a dead horse.
- Occupational Health and Safety Organization (OSHA) mandates wire rope slings made with U-bolts shall not be used for overhead lifting with the following exception: where the application precludes the use of prefabricated slings and where the sling is designed for the specific application by a qualified person.
- The design factor of wire rope terminated with U-bolts is 80% of the original breaking strength. This shall be taken into account when calculating the design factor of 5-to-1.
- Wire rope slings used for overhead lifting shall have a permanently affixed and legible tag indicating the working load limit for the types of hitches used, the angle upon which it is based and the number of legs, if more than one.
- Wire core ropes must not be used at temperatures above 400°F (200°C)
- Fiber core ropes must not be used at temperatures above 180°F (80°C)

Wire Rope Clip Application Instructions



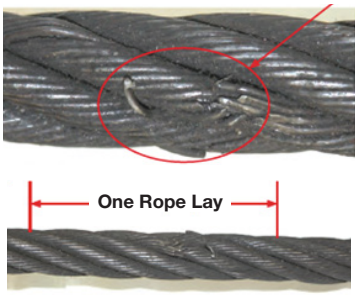
1. Turn specified amount of rope back from thimble or loop. Apply first clip one base width from dead end of rope. Apply U-bolt over dead end of wire rope – live end rests in saddle. Tighten nuts evenly, alternate from one nut to the other until the desired amount of torque is reached.
2. When two clips are required, apply the second clip as near the loop or thimble as possible. Tighten nuts evenly, alternating until the desired amount of torque is reached. When more than two clips are required, apply the second clip as near the loop or thimble as possible, turn nuts on second clips firmly, but do not tighten. Proceed to Step 3.
3. When three or more clips are required, space additional clips equally between the first two, take up rope slack and tighten nuts on each U-bolt evenly, alternating from one nut to the other until the desired amount of torque is reached.
4. Apply an initial load equal to that expected in use. Inspect for proper orientation and spacing of clips and retighten the nuts to the recommended torque.

Inspection Criteria for Wire Rope Slings

CAUTION

Do not inspect slings by passing bare hands over the wire rope.

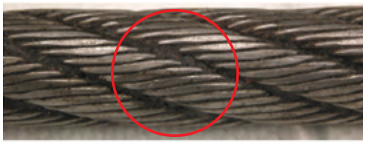
All slings should be inspected for damage prior to each use to assure their strength has not been compromised. The following photos illustrate common damage indicating that the sling must be taken out of service.



Broken Wires

What to look for: The individual wires that make up the strands in a wire rope can break for various reasons, including fatigue and overload. Wire rope slings must be taken out of service when you find ten or more broken wires in one rope lay or five or more broken wires in one strand of one rope lay.

To Prevent: Avoid pulling rope across edges of protrusions.



Wear

What to look for: Flat areas on the individual wires. When wires have lost one third or more of their original diameter, the sling must be taken out of service.

To Prevent: Do not drag the sling on the ground and do not drag loads over the slings. Pad high-wear areas.

Corrosion/Heat Damage

What to look for: Absence of lubrication and discoloration of the rope.

To Prevent: Hang slings away from moisture for storage. Do not use wire core slings above 400°F or fiber core slings above 180°F.

Kinking/Bird Caging

What to look for: Bent strands of wire or strands standing out from their regular position in the body of the sling.

To Prevent: Protect rope from sharp edges of the load by pads or other means. Do not shock-load slings.

Crushing

What to look for: A section of rope that is flattened and the cross-section is no longer round.

To Prevent: Never allow loads to be set on top of slings.