

Wire Rope

Safe Use, Installation, and Inspection



SC&RA



W CRANE & RIGGING
WORKSHOP



Specialized
Carriers
& Rigging
Association

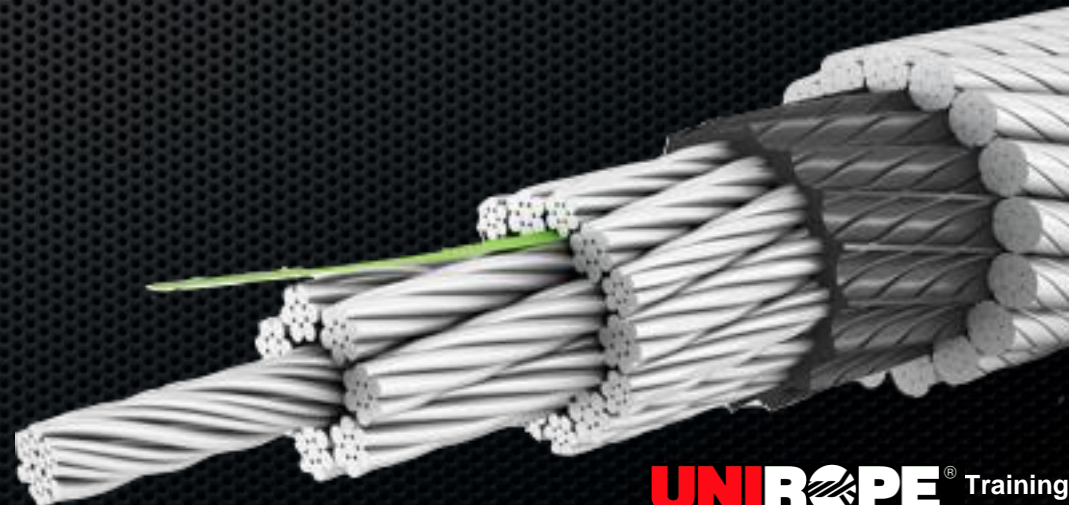
SEPTEMBER 21-23, 2011

SHERATON PHILADELPHIA CITY CENTER, PHILADELPHIA, PA



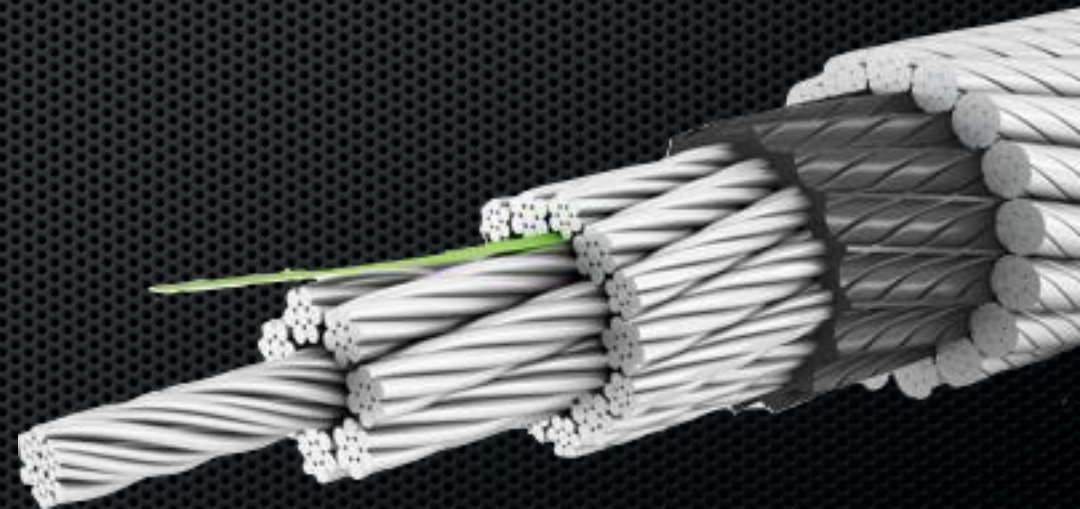
Wire Rope Handling Procedures

- Part A: **Basic Information About Safe Use**
- Part B: **Wire Rope Handling Procedures**
- Part C: **Inspection**
- Part D: **Maintenance**



Wire Rope Handling Procedures

- Part A: **Basic Information About Safe Use**



Basic Information

About the Safe Use of Wire Rope



- ✦ Wire rope WILL fail if worn out, overloaded, misused, damaged or improperly maintained
- ✦ In service, wire rope loses strength
- ✦ The Minimum Breaking Strength of wire rope only applies to new, unused rope



Basic Information About the Safe Use of Wire Rope



- The Minimum Breaking Strength (MBS) should be considered the straight line pull with both ends fixed to prevent rotation
- A wire rope should NEVER be used beyond 50% of its MBS



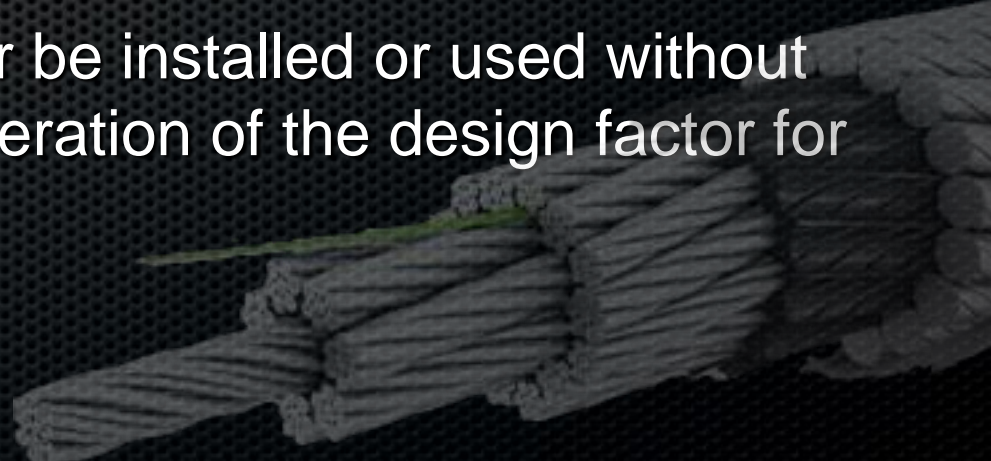
Basic Information

About the Safe Use of Wire Rope



❖ What is the Working Load Limit?

- ❖ The reduction of the MBS (by the design factor) as determined by the application.
- ❖ Design factors are determined by DIN, ISO, CEN, OSHA, ANSI, ASME etc.
- ❖ No Wire Rope should ever be installed or used without full knowledge and consideration of the design factor for the application.

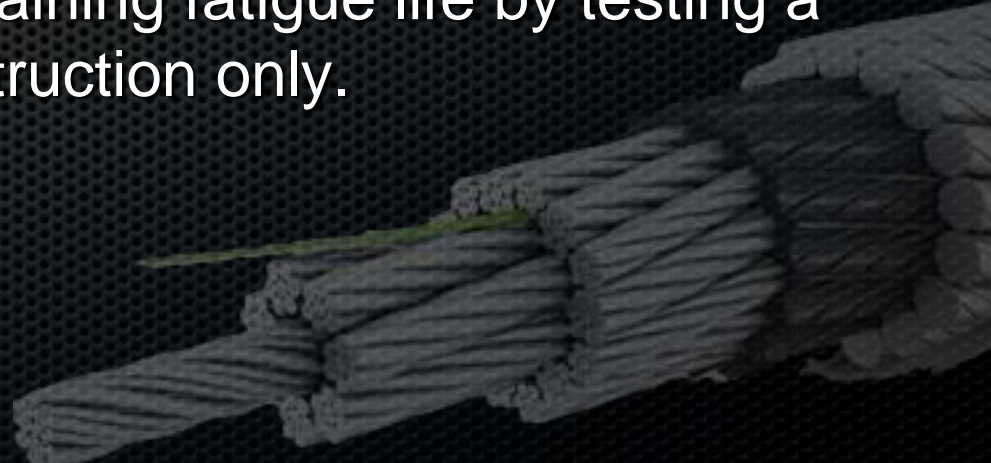


Basic Information About the Safe Use of Wire Rope



❖ Wire Rope Wears Out!

- ❖ When approaching its finite fatigue life, a wire rope's strength will sharply decrease.
- ❖ Never evaluate the remaining fatigue life by testing a portion of a rope to destruction only.



Basic Information About the Safe Use of Wire Rope



- Never Overload a Wire Rope ... Not even beyond the WLL
- Never Shock Load a Wire Rope
 - There is no practical way to evaluate the force applied by shock loading a wire rope



Basic Information About the Safe Use of Wire Rope



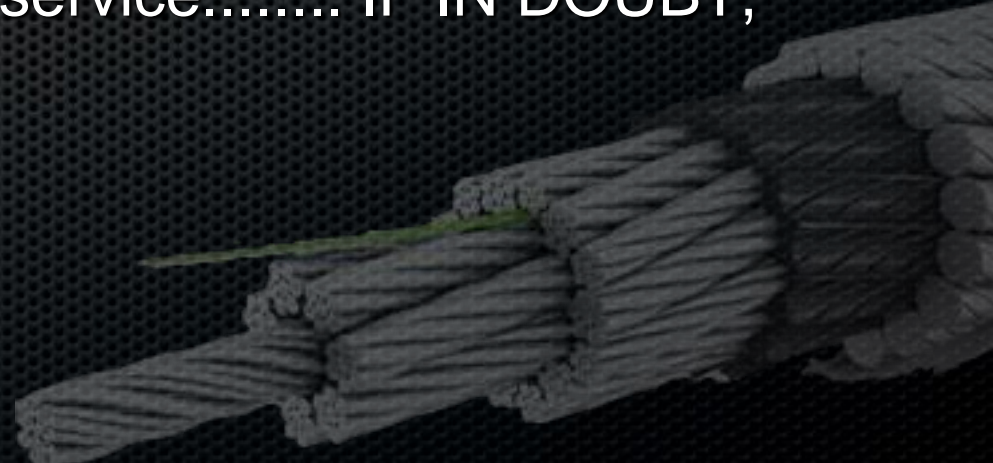
- Lubricant is extremely important to wire rope life
- Reduction of Wear Between
 - Wires and Strands
 - Rope and Sheaves/Drum



Basic Information About the Safe Use of Wire Rope



- Regular, periodic inspections of the wire rope, and keeping of permanent records signed by a qualified person are required for almost every rope installation.
- The purpose of an inspection is to determine if the wire rope can safely remain in service..... **IF IN DOUBT, REPLACE THE ROPE.**



Basic Information About the Safe Use of Wire Rope



- A wire rope removed from service because it is no longer suitable cannot be reused in another application.
- Each Type of fitting attached to a wire rope has a specific efficiency rating which can reduce the WLL of a rope assembly or rope system.



Basic Information About the Safe Use of Wire Rope

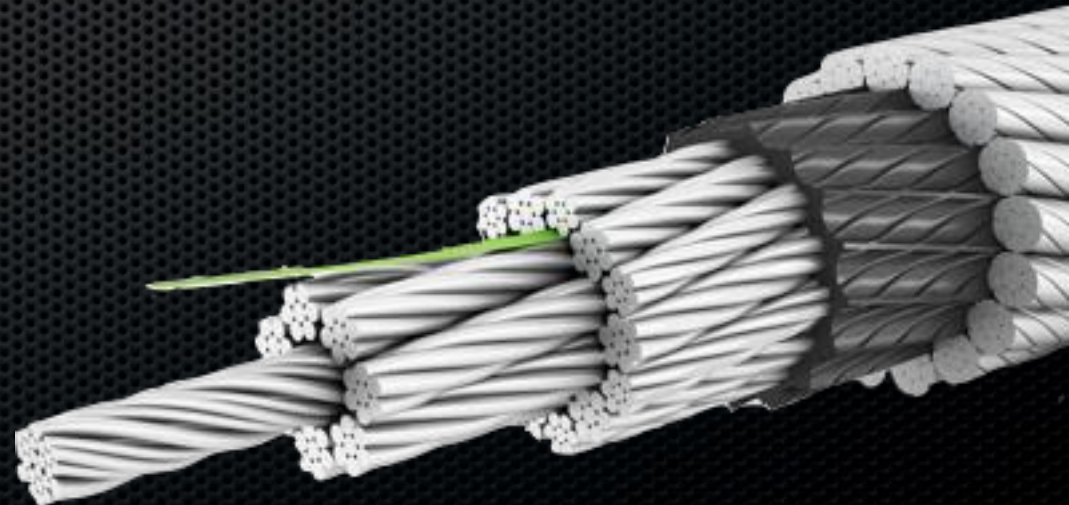


- **Some conditions that can lead to problems in a wire rope system include**
 - Sheaves that are too small, worn or corrugated
 - Broken wires mean a loss in strength
 - Kinks permanently damage a wire rope
 - Environmental factors such as heat or corrosive conditions
 - Lack of Lubrication
 - Contact with electrical wire or lightning



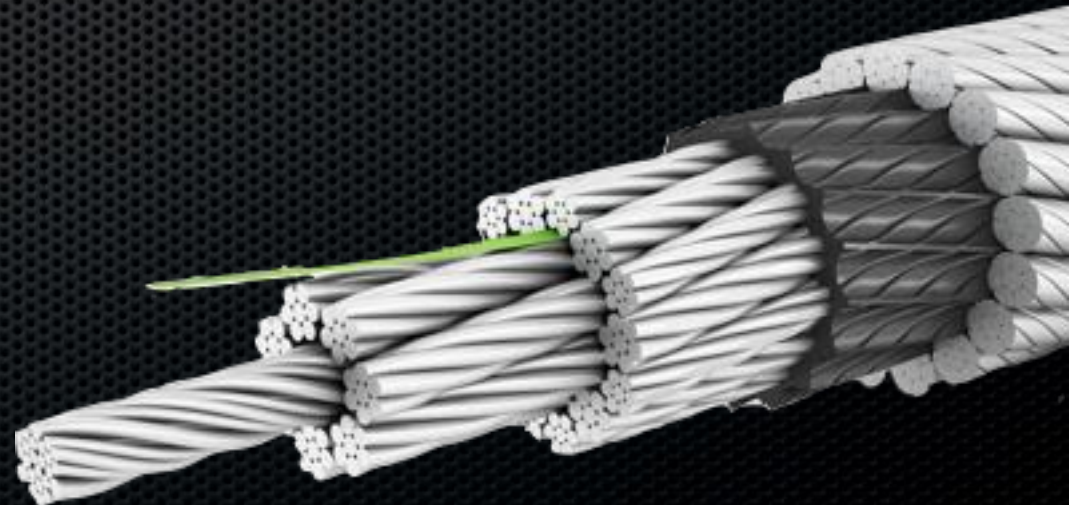
Wire Rope Handling Procedures

- **Part A: Basic Information About Safe Use**
- **Part B: Wire Rope Handling Procedures**
- **Part C: Inspection**
- **Part D: Maintenance**



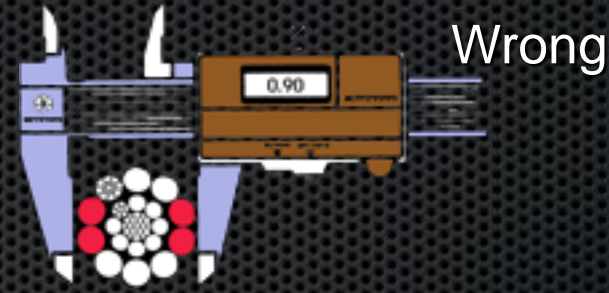
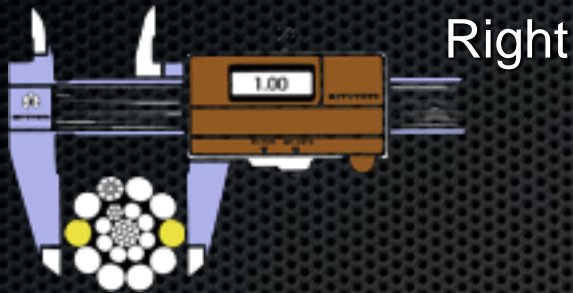
Wire Rope Handling Procedures

- **Part B: Wire Rope Handling Procedures**



Wire Rope Diameter

Determine the correct wire rope diameter



ALL wire rope have a diameter tolerance

5% Diameter Tolerances			
Nominal Diameter inch	Maximum Diameter inch	Nominal Diameter mm	Maximum Diameter mm
3/8	.395	10	10.5
7/16	.46	11	11.5
1/2	.525	12	12.6
9/16	.590	14	14.7
5/8	.65	15	15.7
3/4	.79	16	16.8
7/8	.92	18	18.9
1	1.05	20	21.0
1-1/8	1.18	22	23.1
1-1/4	1.31	24	25.2
1-3/8	1.44	26	27.3
1-1/2	1.58	28	29.4
1-5/8	1.71	30	31.5
1-3/4	1.84	32	33.6
1-7/8	1.97	34	35.7
2	2.10	36	37.8

Type of Rope Lay and Direction

Regular Lay

Individual wires parallel to rope axis

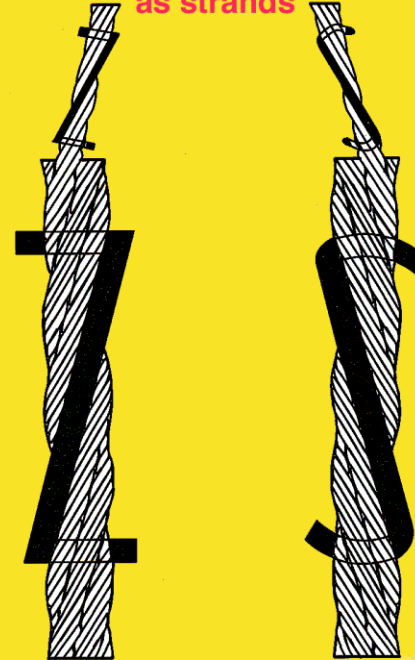


Right Lay
sZ
(RRL)

Left Lay
zS
(LRL)

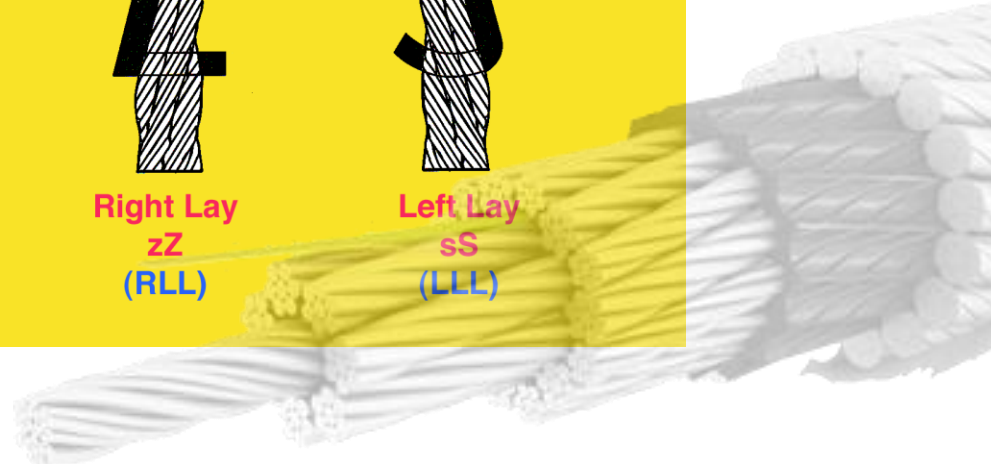
Lang Lay

Individual wires in same direction as strands



Right Lay
zZ
(RLL)

Left Lay
sS
(LLL)



Rope Lay direction versus Drum Groovin



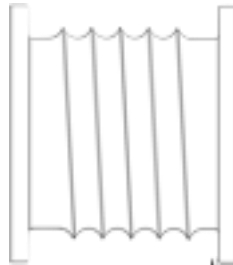
Left Lay Rope



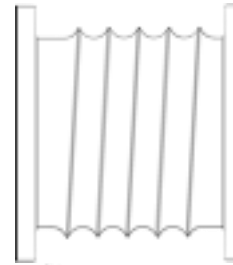
Right Lay Rope



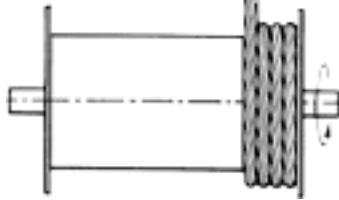
Right Hand Grooved: Used Left Hand Rope



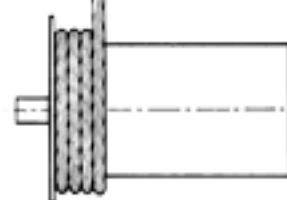
Left Hand Grooved: Used Right Hand Rope



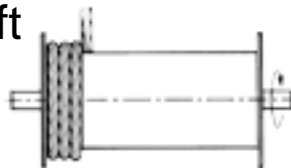
Overwind from right to left: Use Left Hand Rope



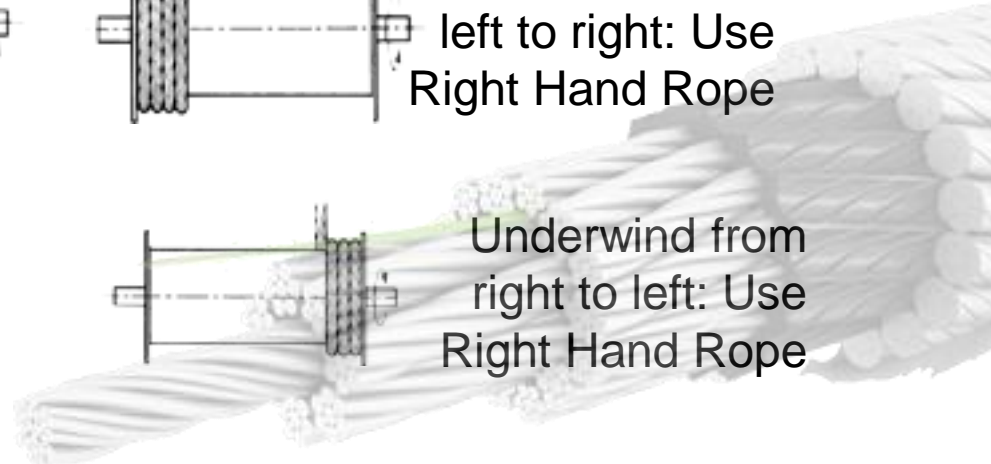
Overwind from left to right: Use Right Hand Rope



Underwind from left to right: Use Left Hand Rope



Underwind from right to left: Use Right Hand Rope



Mobile Crane Rope Installation

Unreeling the wire rope



Wire Rope Installation

Winding the rope on to the drum



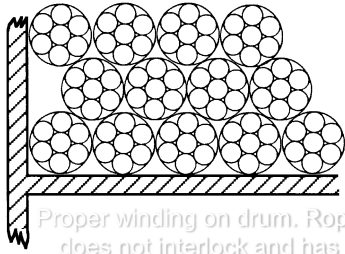
Wire Rope Installation

Winding the rope on to the drum

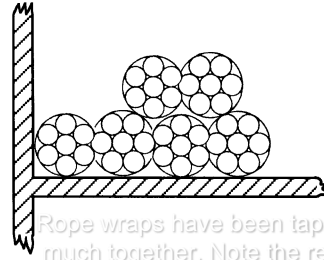


Mobile Crane Rope Installation

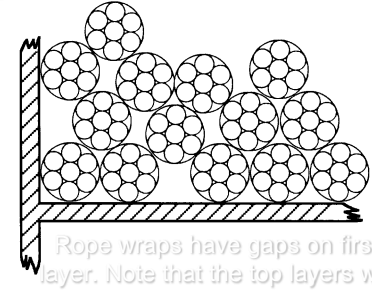
Winding the rope on to the drum



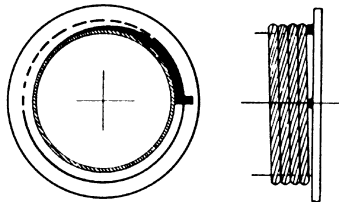
Proper winding on drum. Rope does not interlock and has enough pre-tension not to damage the bottom layers.



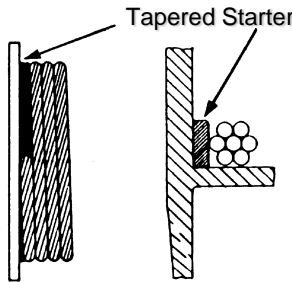
Rope wraps have been tapped too much together. Note the resulting strand interlocking. The rope will get damaged.



Rope wraps have gaps on first layer. Note that the top layers will not spool properly.

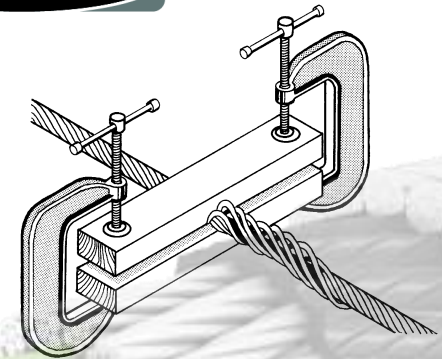


This tapered lifter provides a ramp for the rope to ride up the flange to prevent wedging the rope against the flange and adjacent wraps.

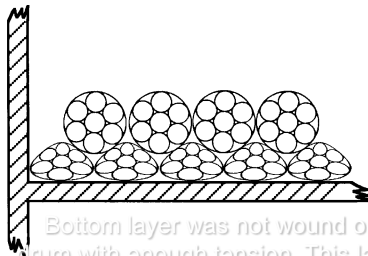


Tapered Starter

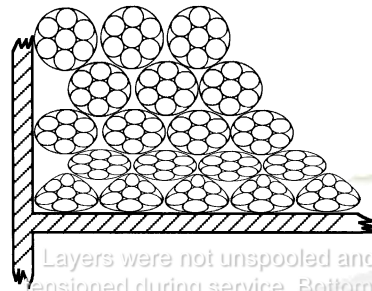
CAUTION



This method of tightening the rope on to the drum WILL destroy the rope.



Bottom layer was not wound on the drum with enough tension. This layer will get crushed by the top layer when loaded to WLL.

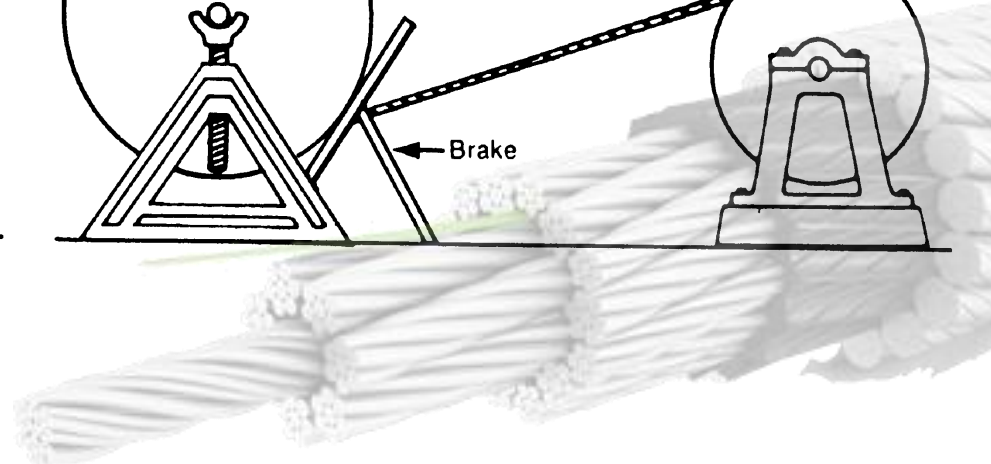
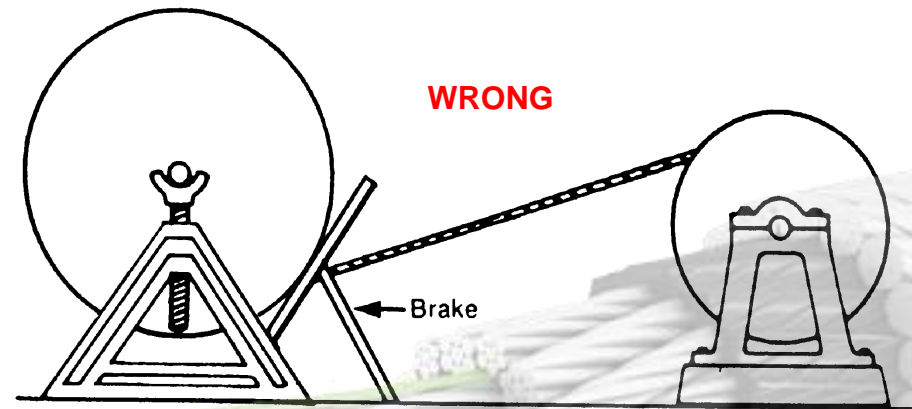
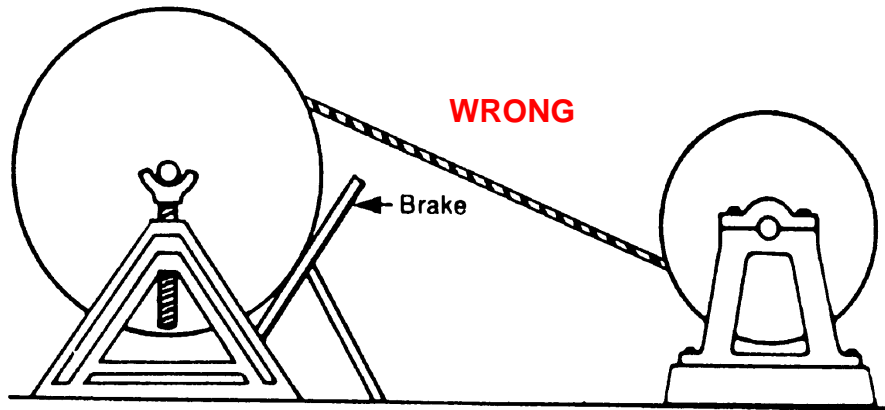


Layers were not unspooled and pre-tensioned during service. Bottom layers will flatten out by the load imposed by the top windings.

Wire Rope Installation

Unreeling a Wire Rope

Many new wire ropes are already damaged if the proper unreeling procedure is not followed:



Mobile Crane Rope Installation



This means trouble !

Disconnect the rope end fitting from the boom and rotate counter to the block twists, same number as the block is rotated around it's axis.

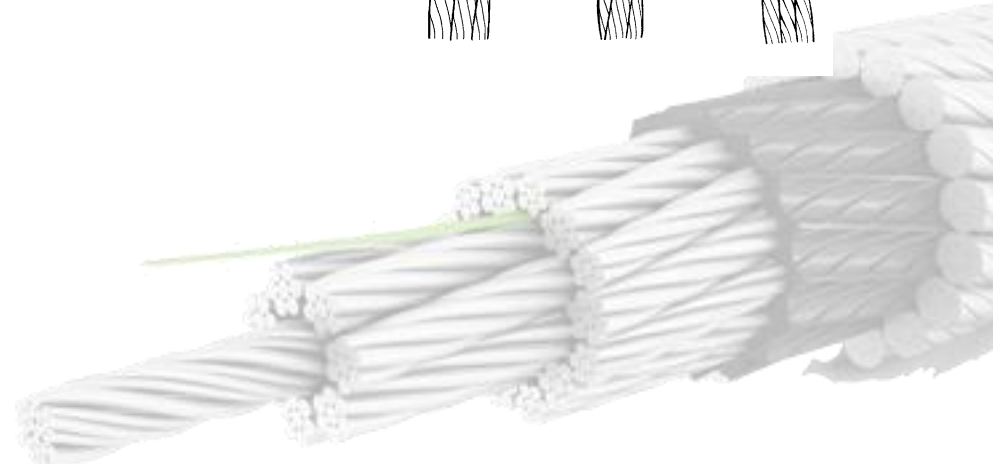
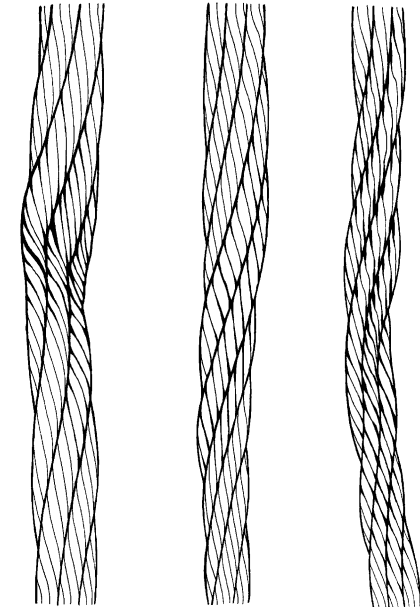
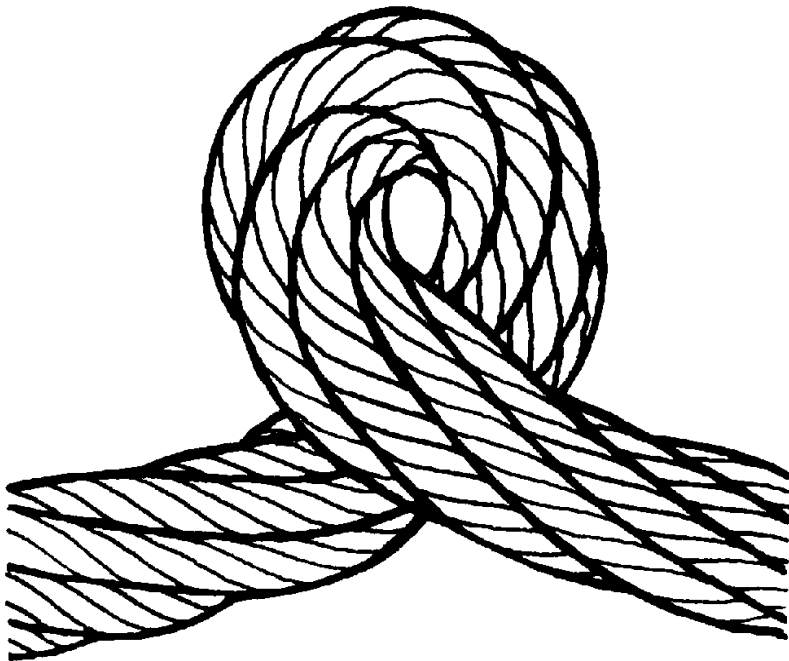
(In this picture rotate the rope 360 degree as the block is twisted just once.



Wire Rope Installation

Unreeling a Wire Rope

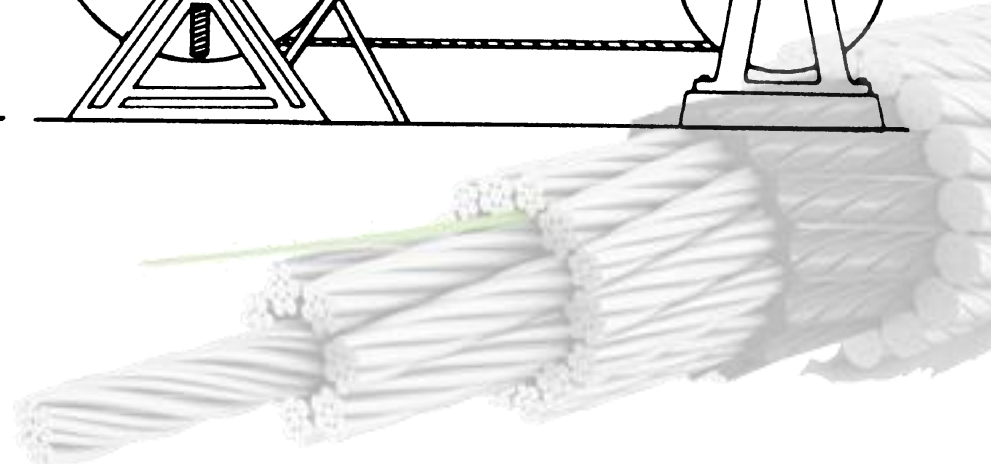
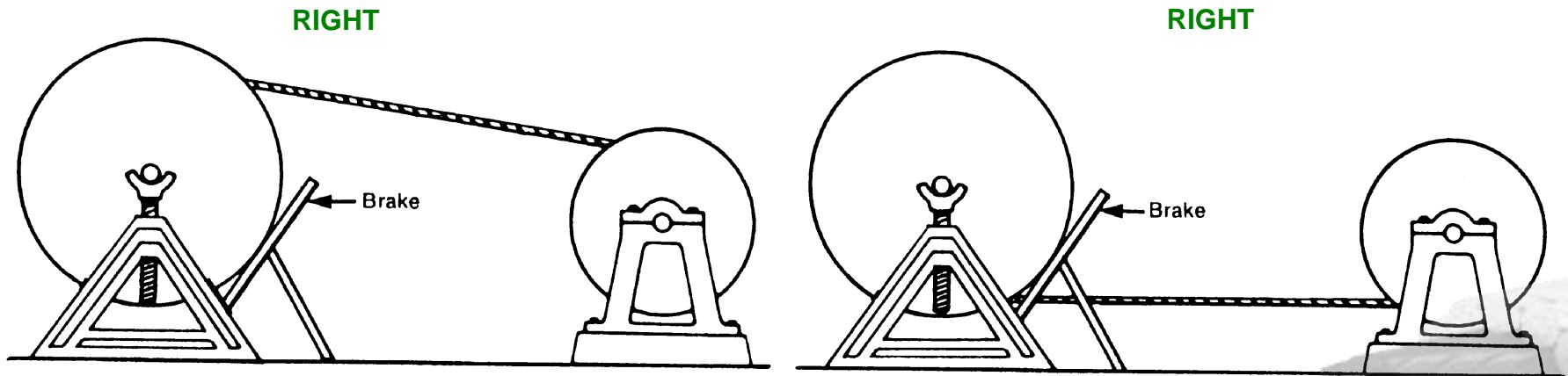
Many new wire ropes are already damaged if the proper unreeling procedure is not followed:



Wire Rope Installation

Unreeling a Wire Rope

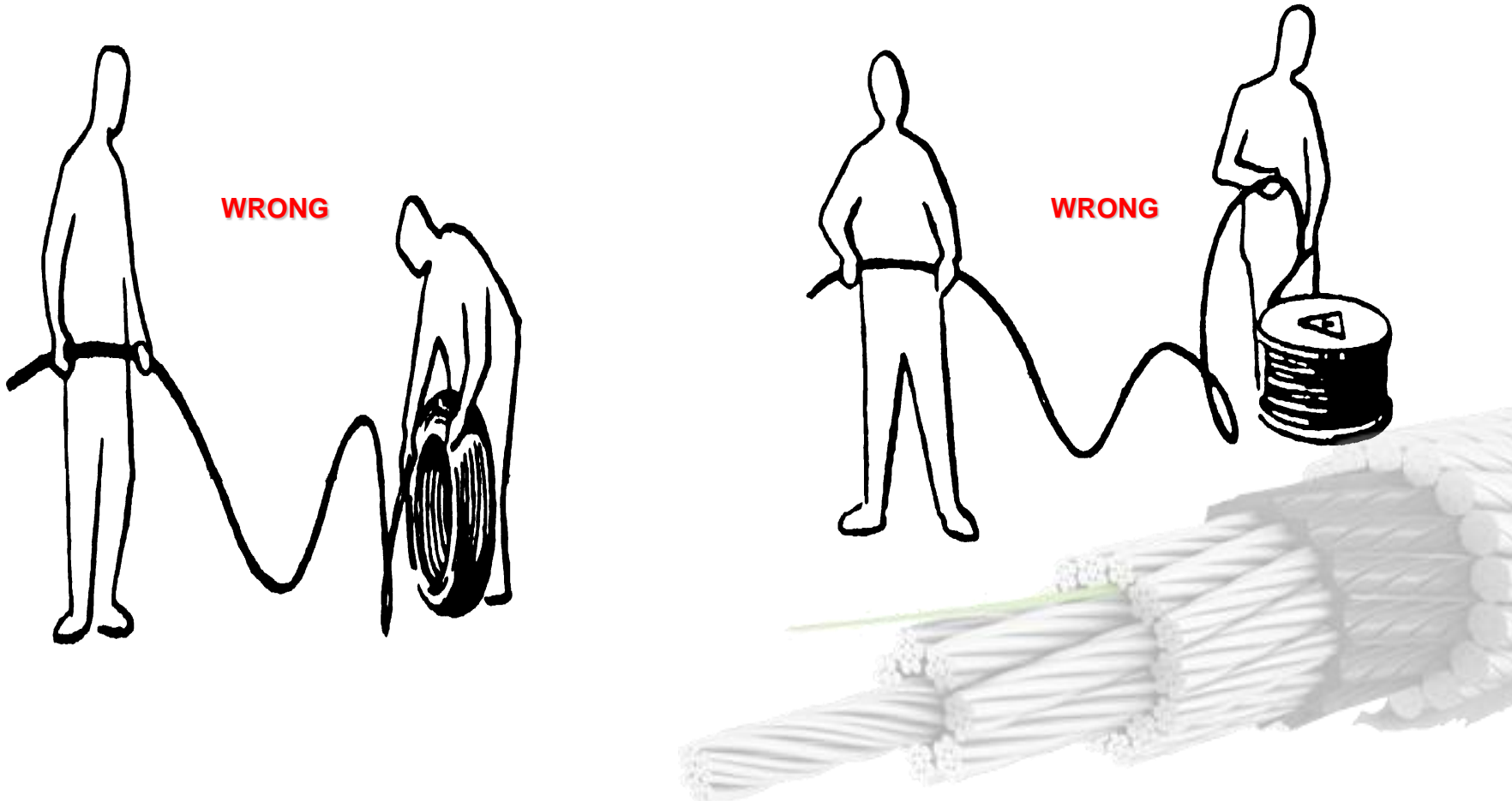
Many new wire ropes are already damaged if the proper unreeling procedure is not followed:



Wire Rope Installation

Unreeling a Wire Rope

Many new wire ropes are already damaged if the proper unreeling procedure is not followed:



Wire Rope Installation



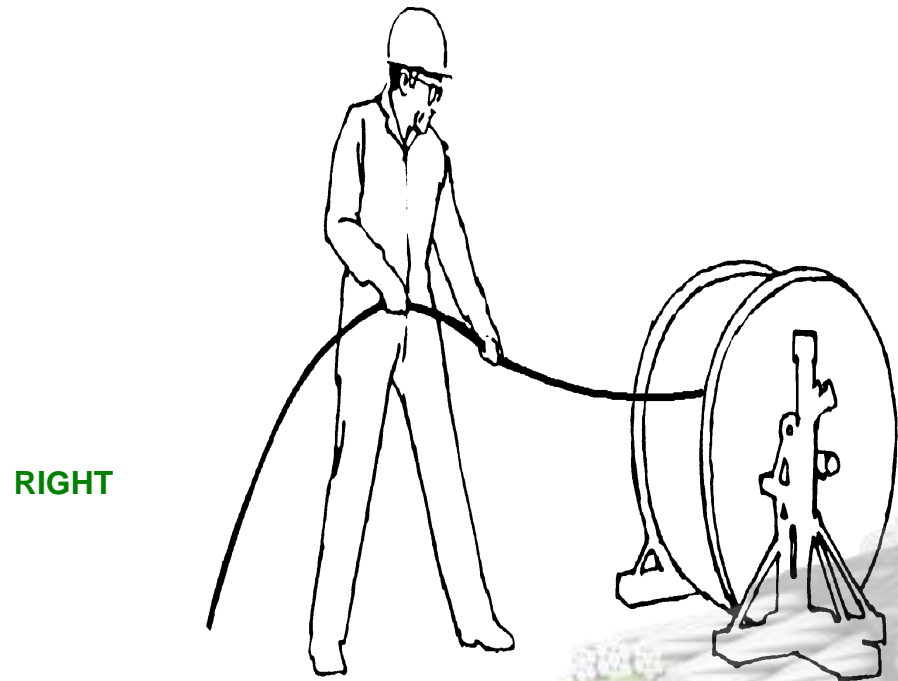
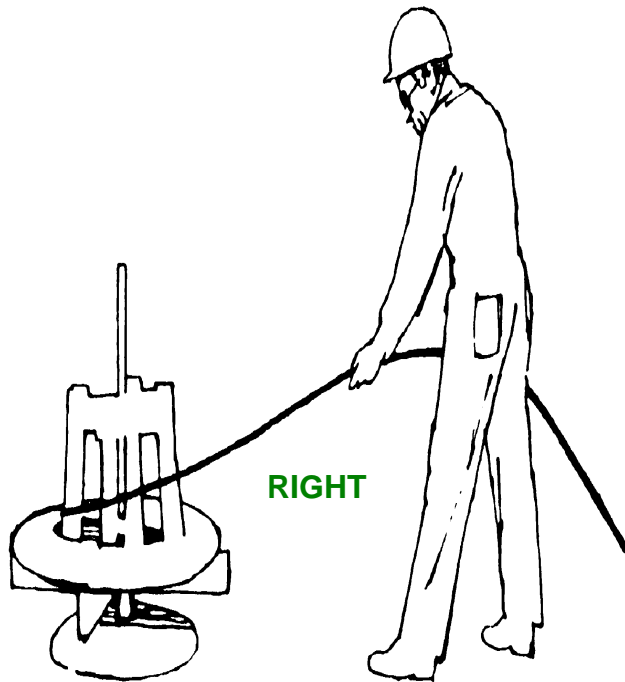
Wire Rope Installation



Wire Rope Installation

Unreeling a Wire Rope

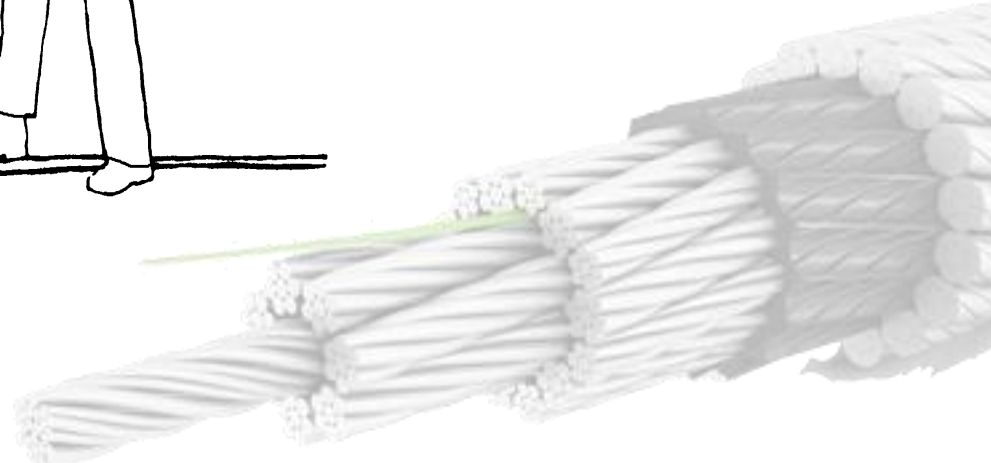
Many new wire ropes are already damaged if the proper unreeling procedure is not followed:



Wire Rope Installation

Unreeling a Wire Rope

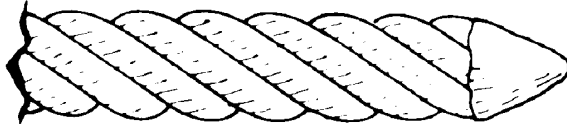
Many new wire ropes are already damaged if the proper unreeling procedure is not followed:



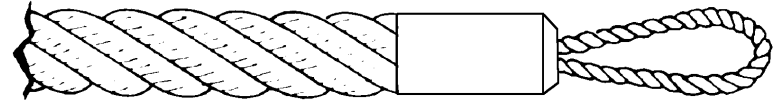
Wire Rope Installation

Connecting the old rope to the new rope

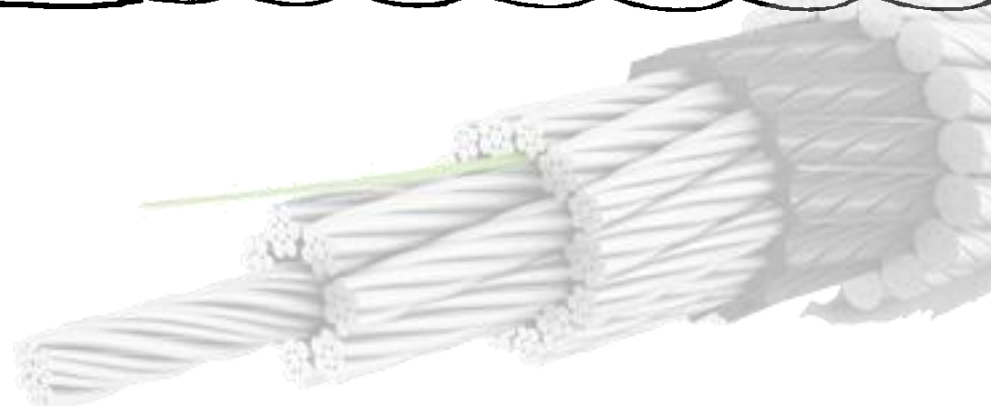
Factory Induction Welded and Tapered End



Becket Loop End

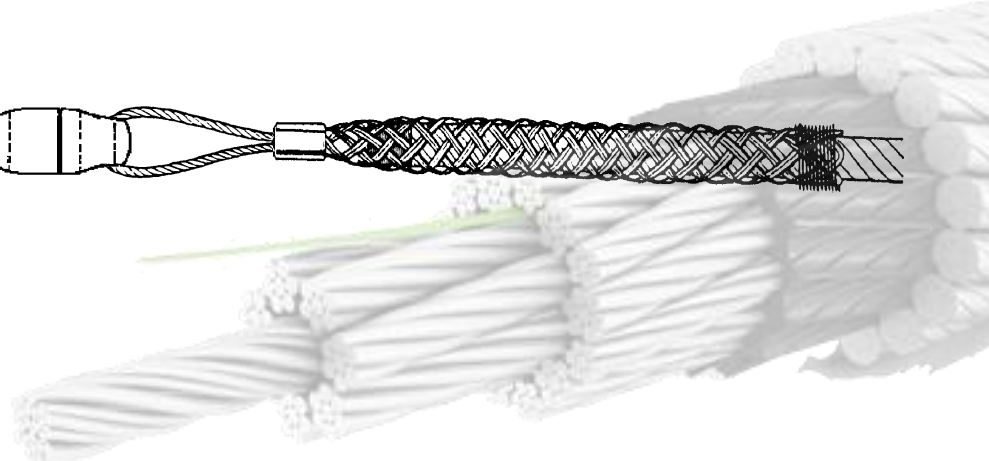
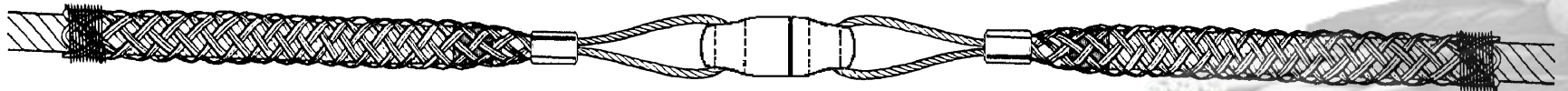
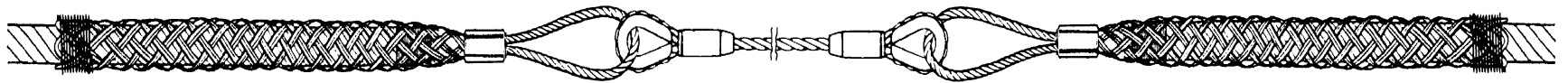


Wire Rope welded together. Danger of the weld breaking when bent around sheaves.



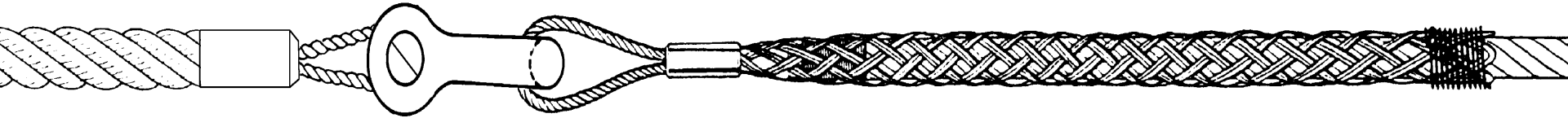
Wire Rope Installation

Two cable grips with eye, connected to two ropes with connecting cable. Use with standard and Python® non-rotating rope

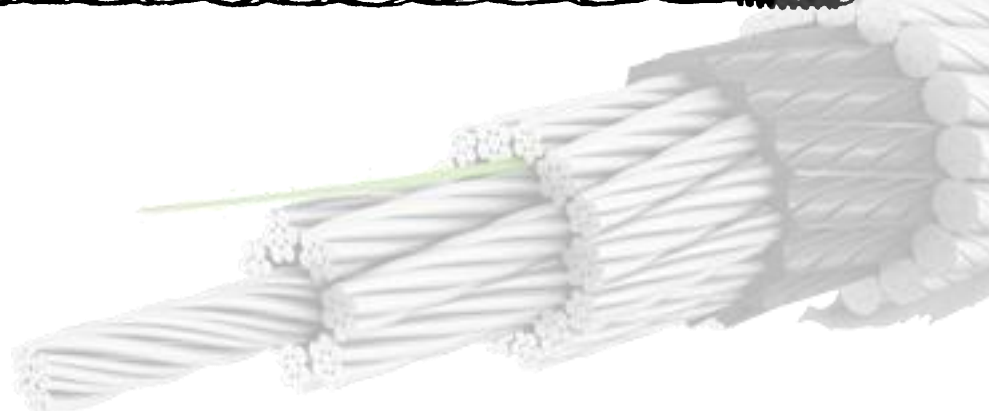


Wire Rope Installation

One cable grip connected to old rope, becket loop factory installed to new rope.



Open-end cable grip connected to two ropes. Commonly used with 6-strand rope.



Wire Rope Installation

Use of cable grips



Length should be between 4' and 6' to grip securely

Wire Rope Installation

NEVER attach a RIGHT hand lay rope to a LEFT hand lay rope!



CAUTION

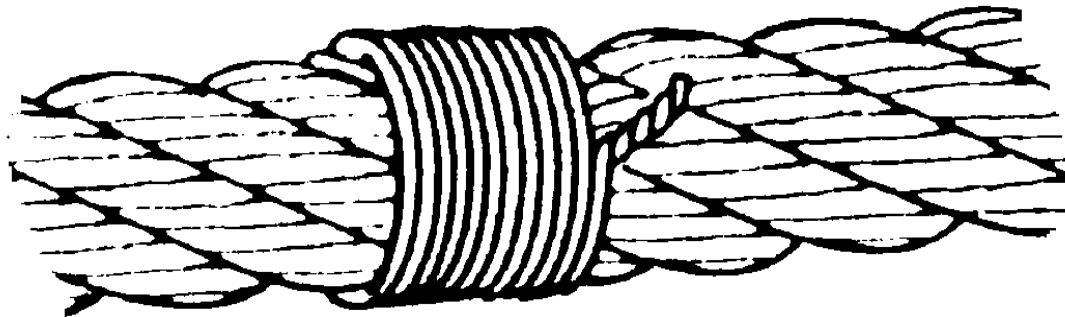


Wire Rope Installation

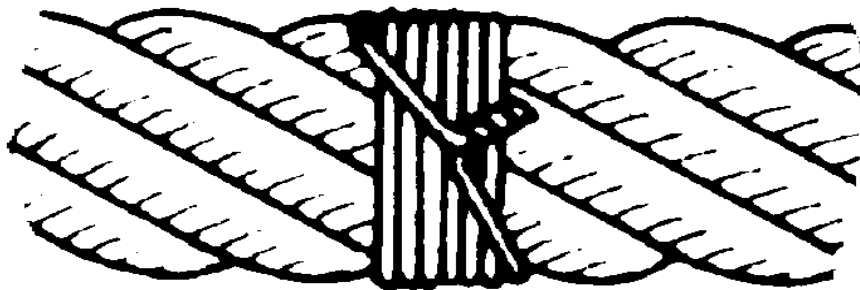
Seizing a Wire Rope

Many wire ropes are 'Preformed' to prevent unraveling when cut. These types are typically seized with tape only.

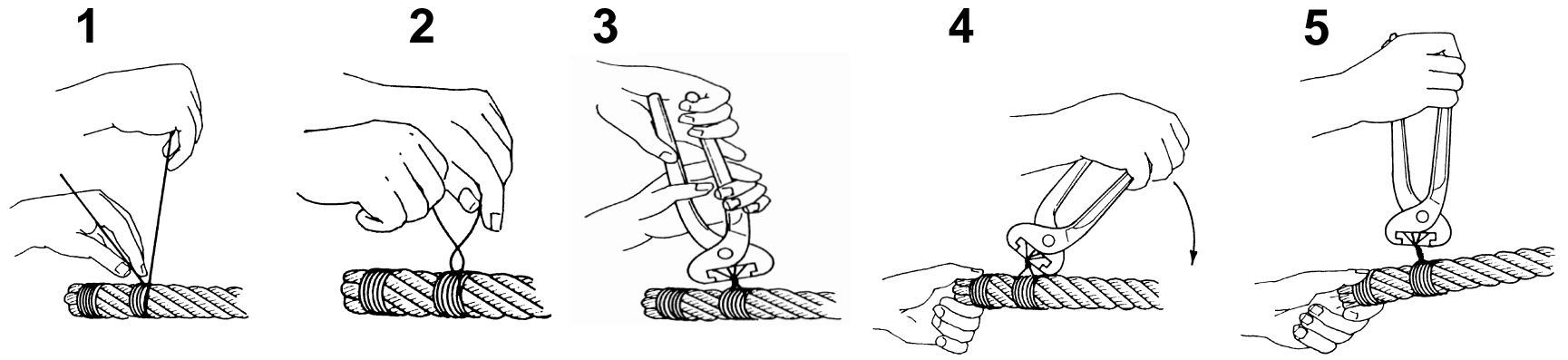
Method A



Method B

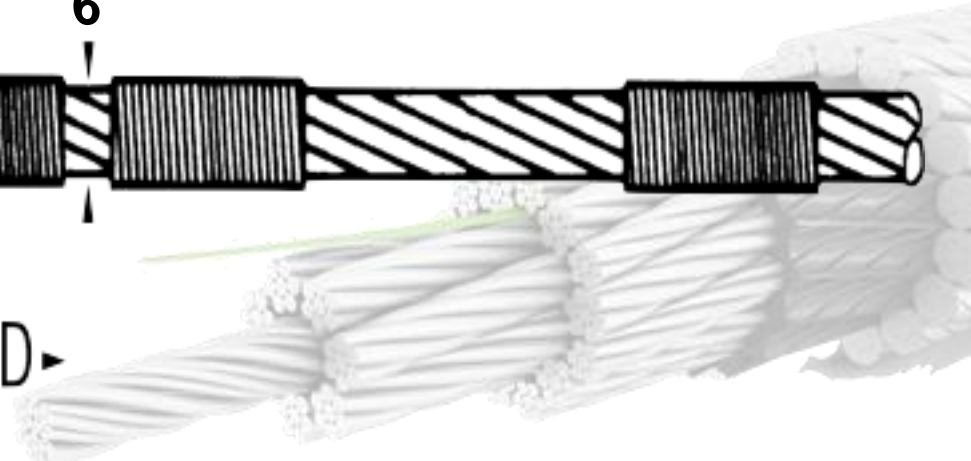
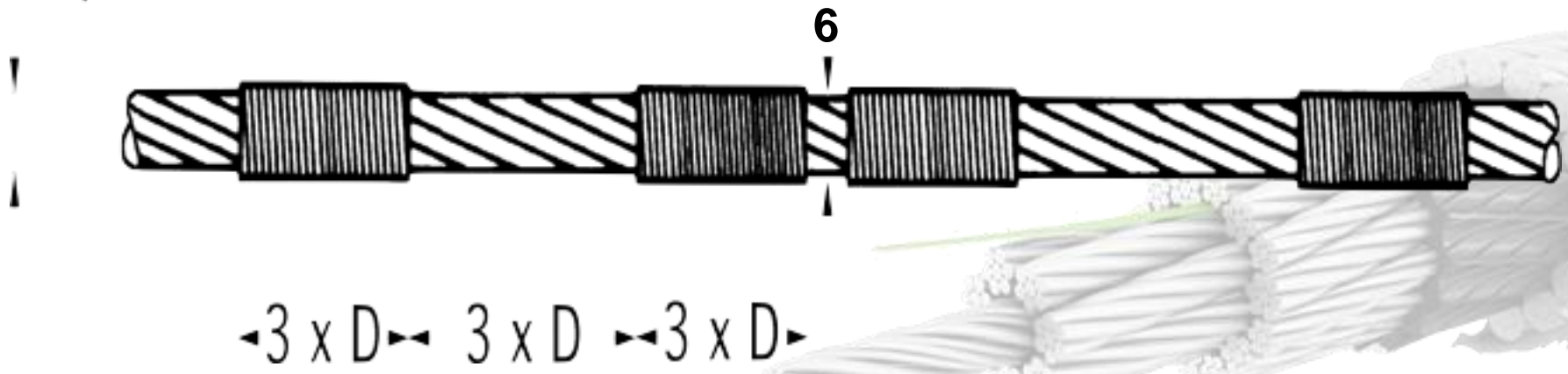


Wire Rope Installation

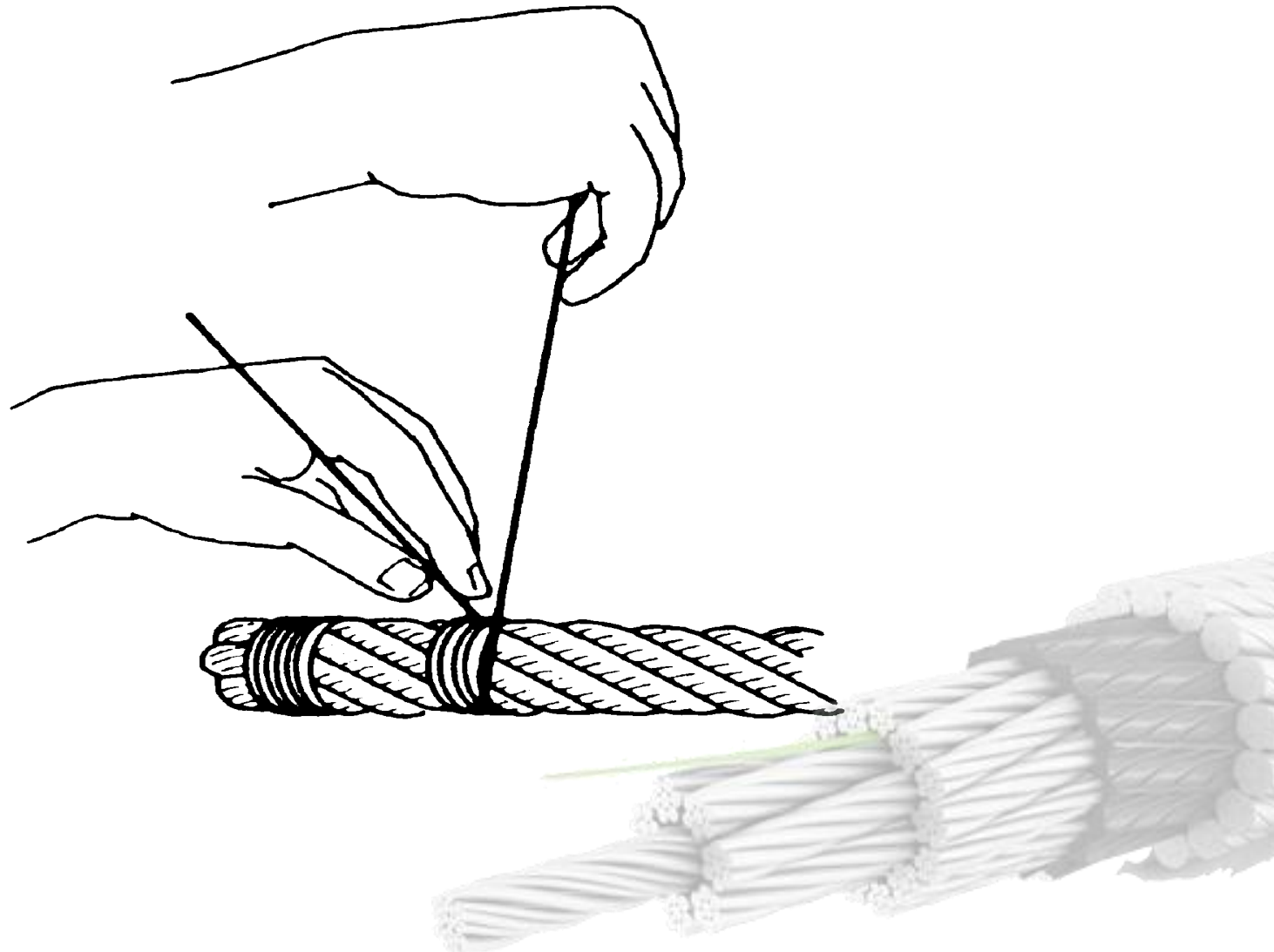


Rope Dia.

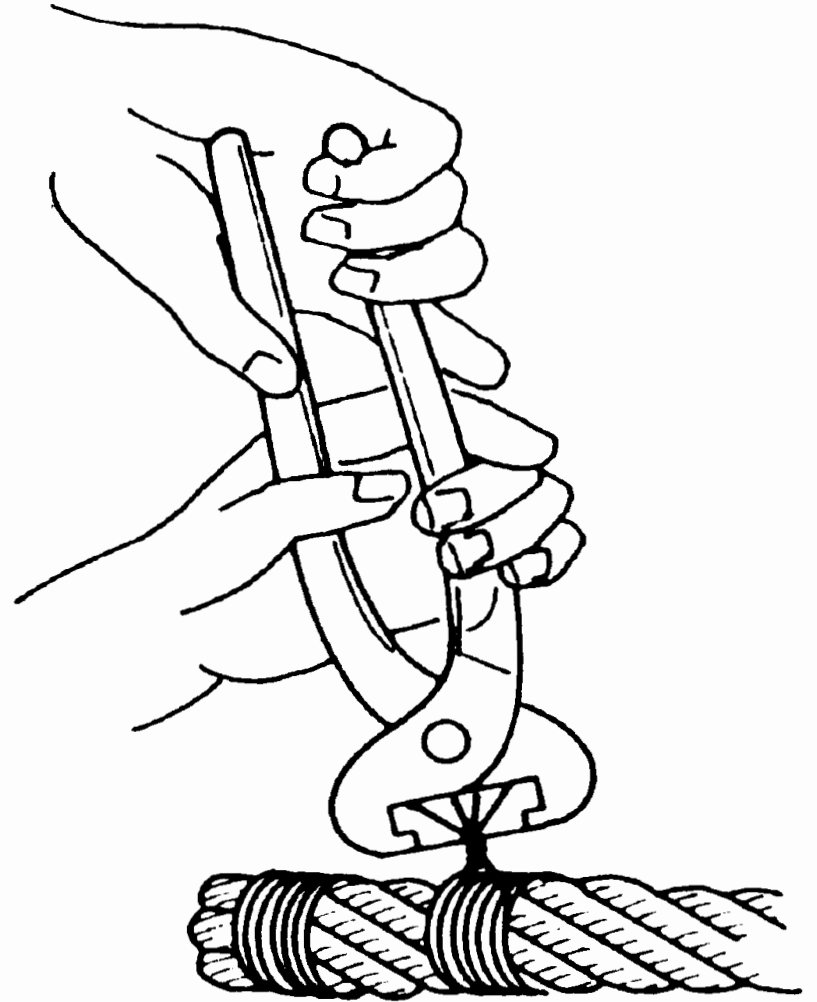
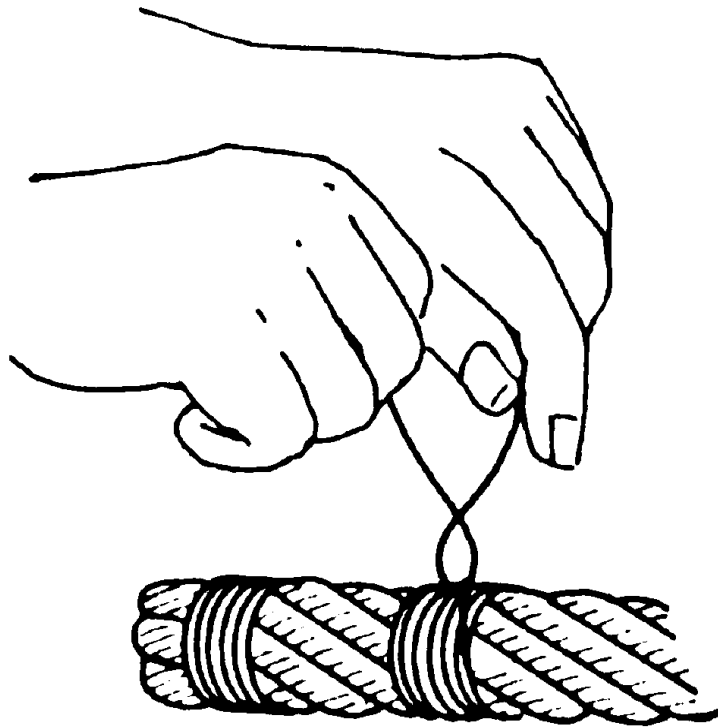
Cut rope here



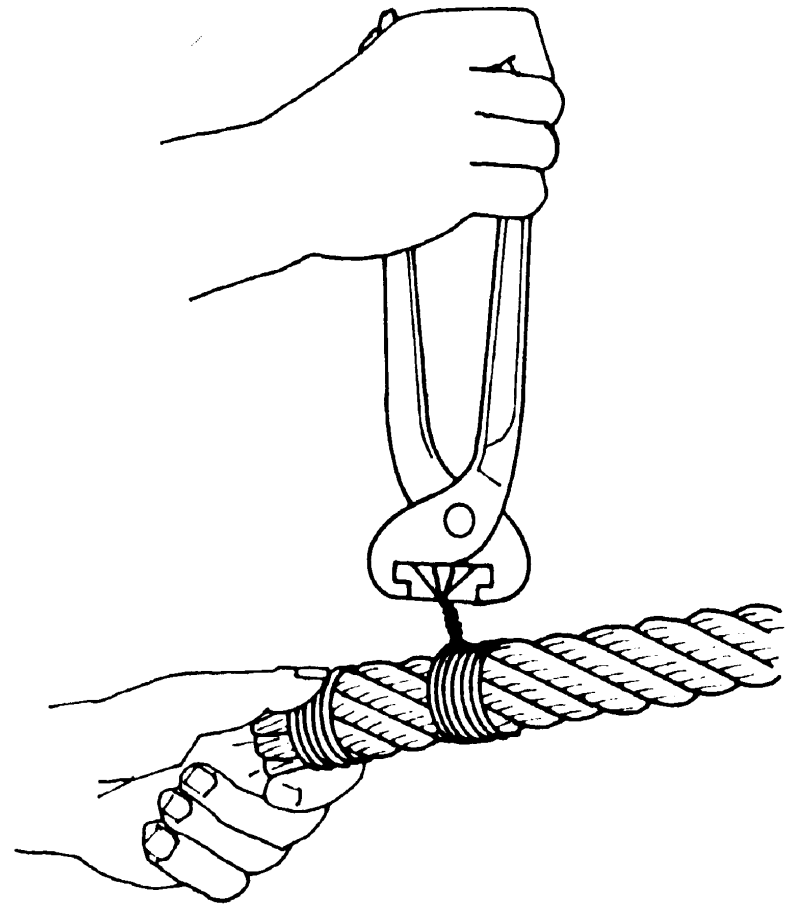
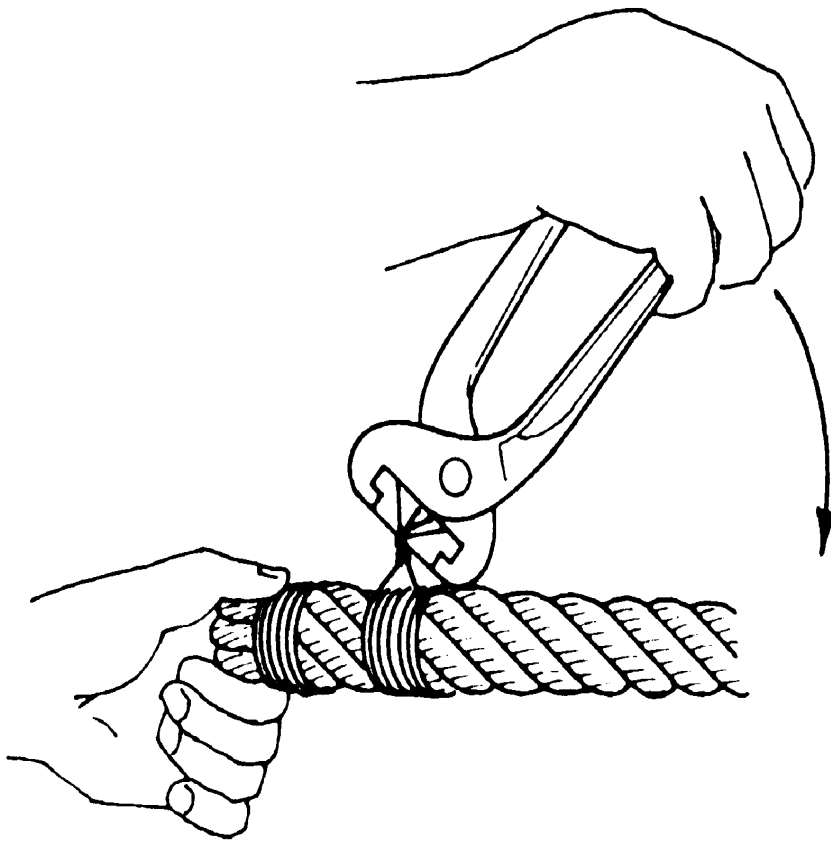
Wire Rope Installation



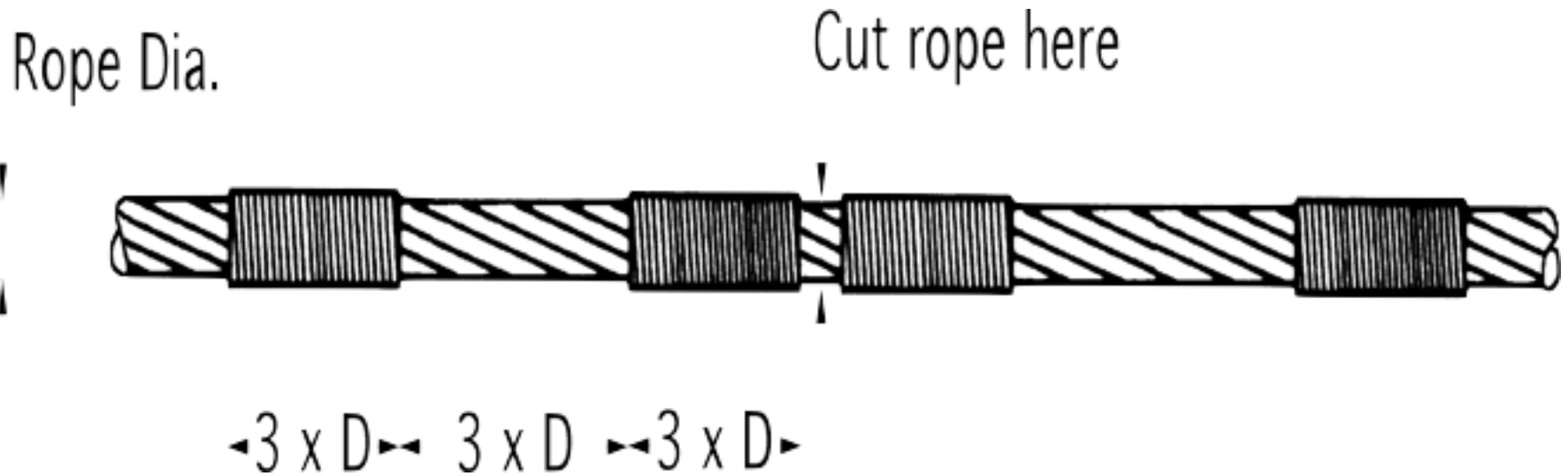
Wire Rope Installation



Wire Rope Installation



Wire Rope Installation



Wire Rope Installation

Cutting the rope



Attach 3 hose clamps on either side of the cut mark

Wire Rope Installation

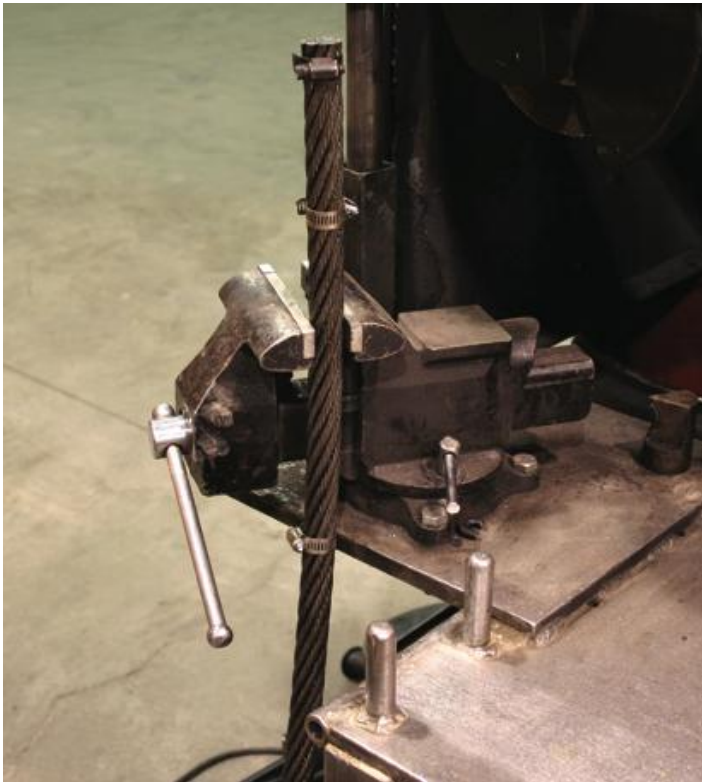
Cutting the rope



Use a steel cutting blade not a grinding wheel !

Wire Rope Installation

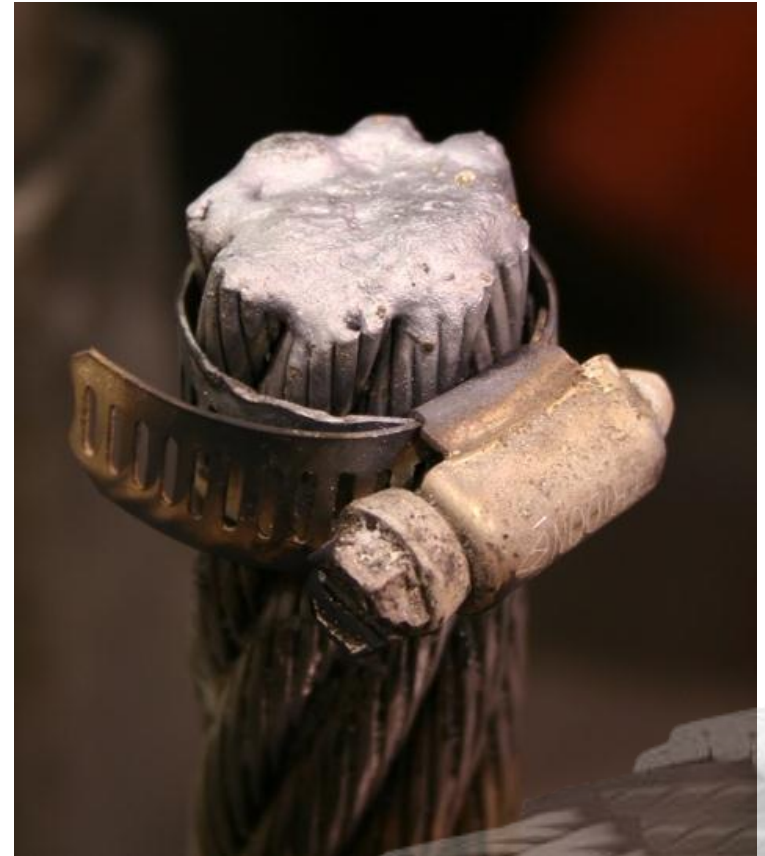
Cutting the rope



Mount upright in vice and melt the wires

Wire Rope Installation

Cutting the rope



Melt and fuse the rope wires together



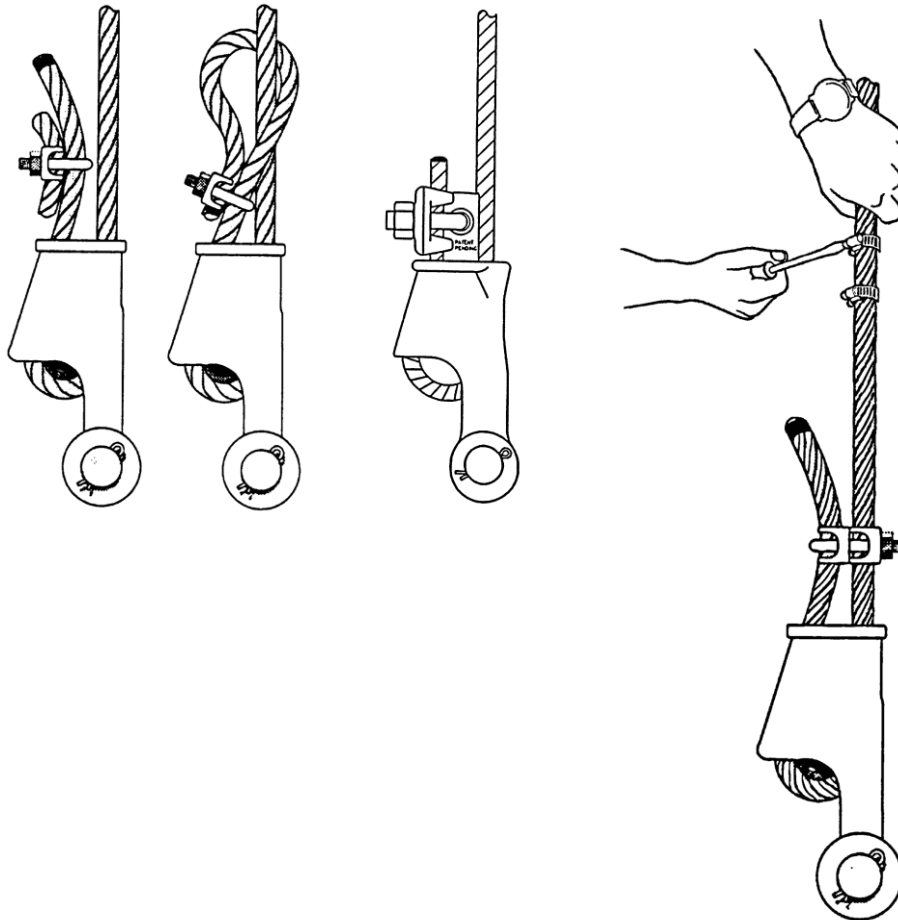
Wire Rope Installation

Factory 'welded-and-taper' ends



Wire Rope Installation

Installing rope into the wedge socket



We recommend to add hose clamps to prevent any rope slack to travel into the working section of the line.

Wire Rope Installation

Installing rope into the wedge socket



Wire Rope Installation

Installing rope into the wedge socket



Wire Rope Installation

Installing rope into the wedge socket



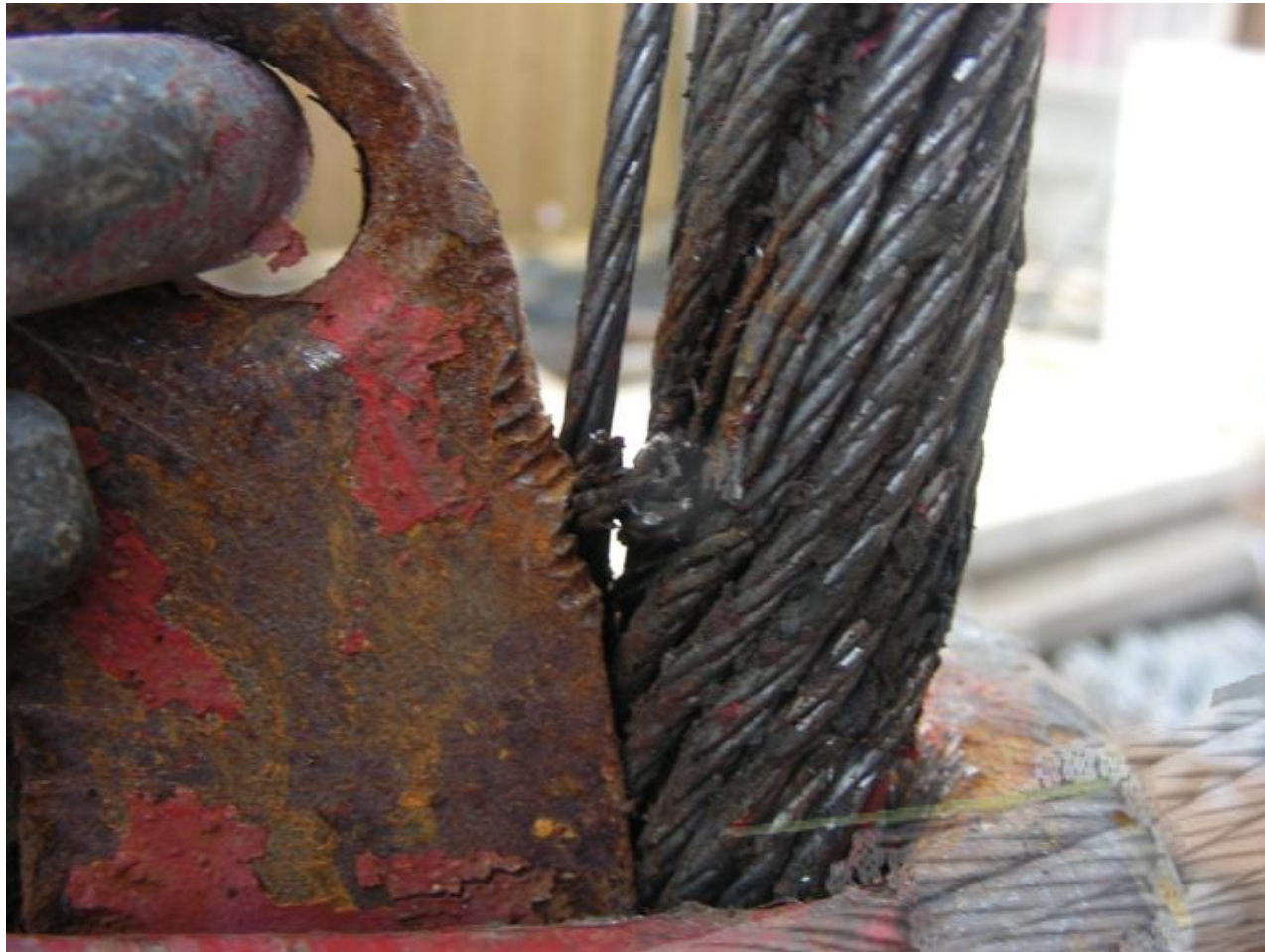
Wire Rope Installation

Installing rope into the wedge socket

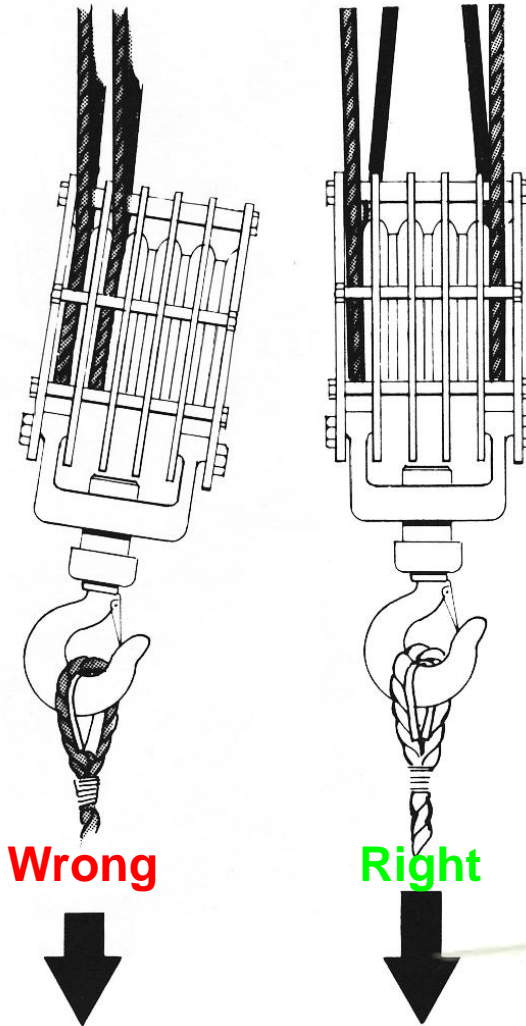


Wire Rope Installation

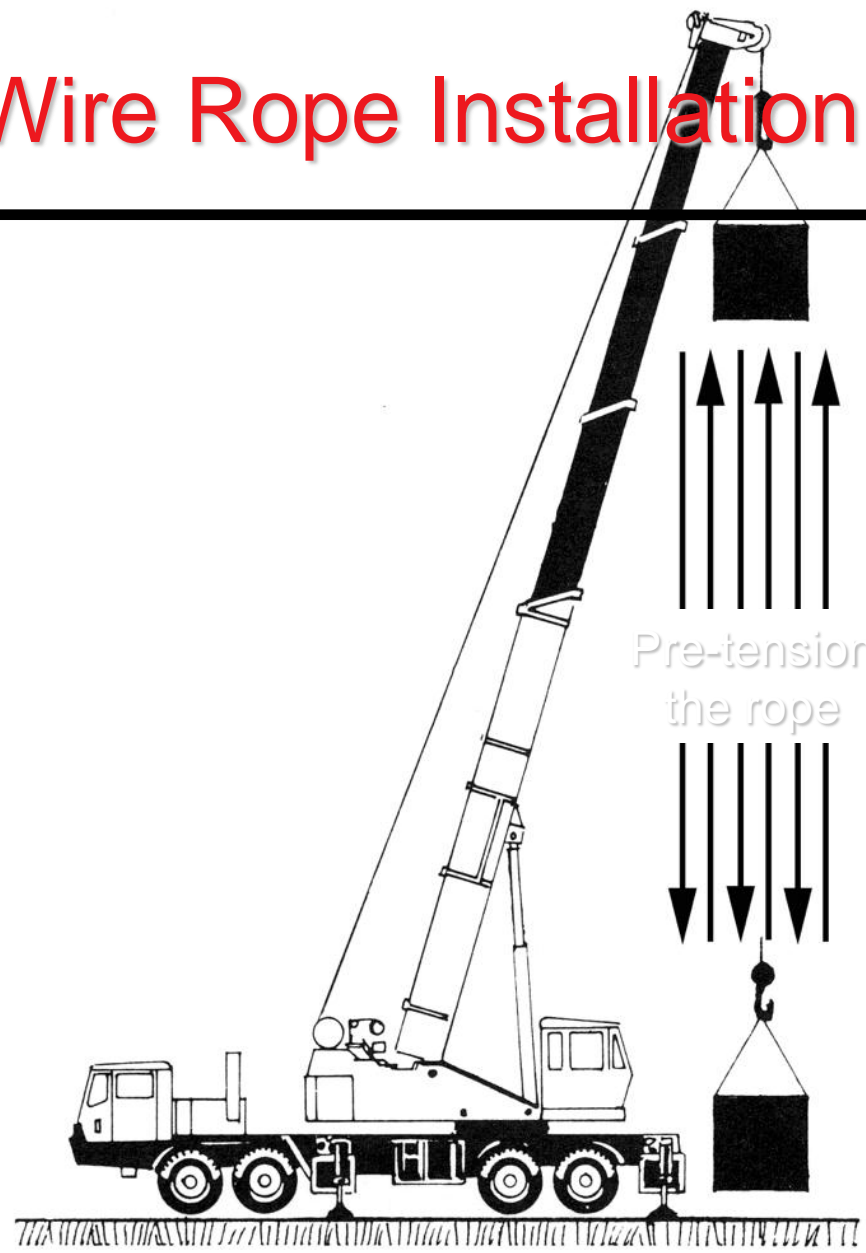
Installing rope into the wedge socket



Mobile Crane Rope Installation

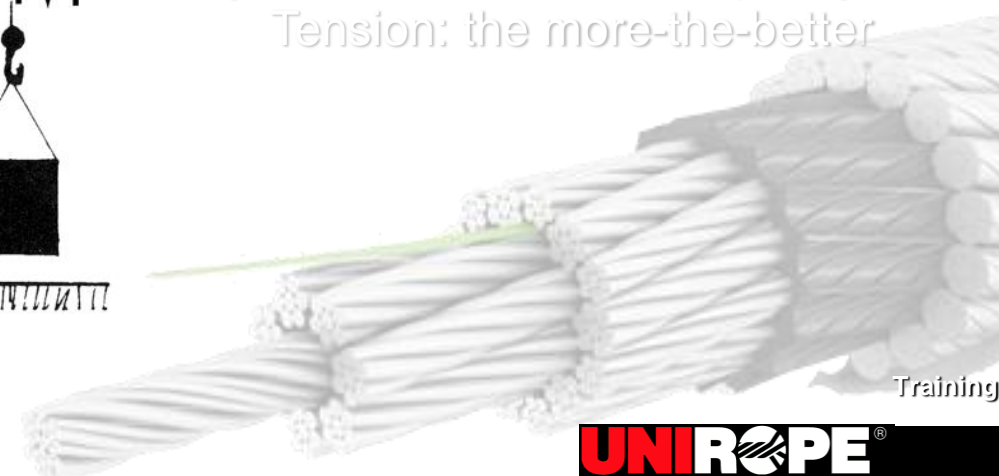


Wire Rope Installation




New rope needs to be run-in to allow all strands and wires for initial adjustment.
5-10% of rope WLL

During service repeat pre-tension cycle to 'harden' lower rope layers.
Tension: the more-the-better

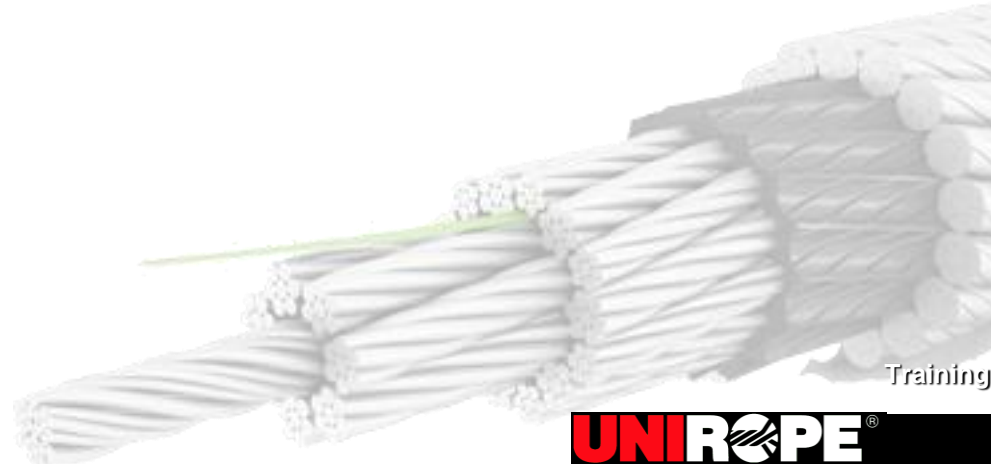


Multiple Layer Drum Damage

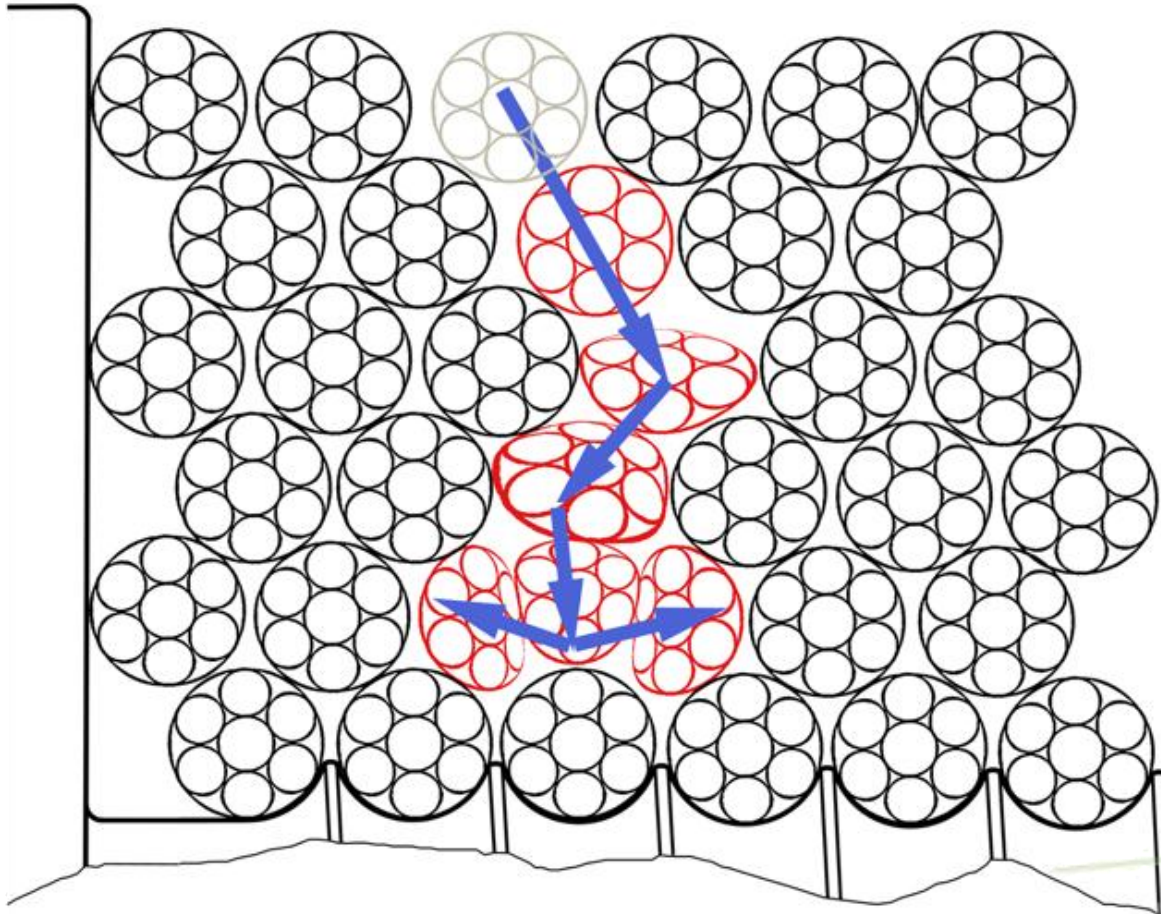


'Heavy lift' line was spooled on to 'slack' line.

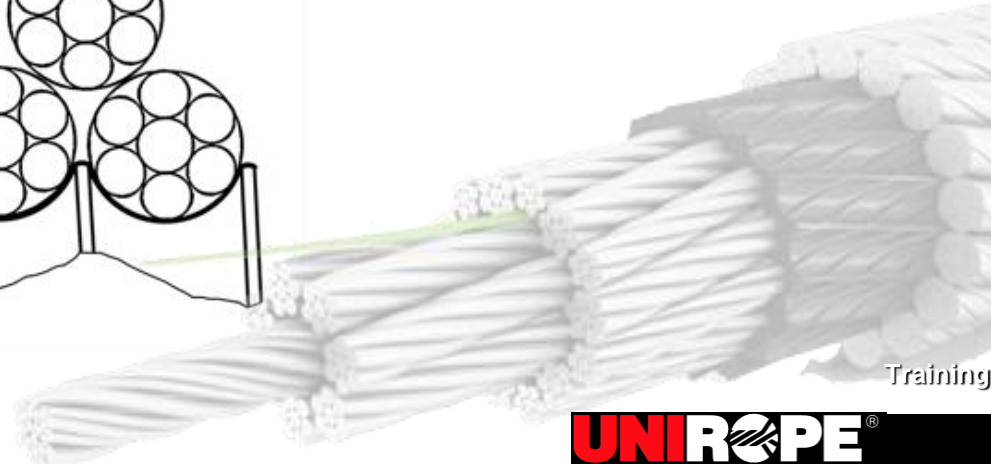
Soft 'slack' line gives way, hard 'heavy lift' line pulled in.



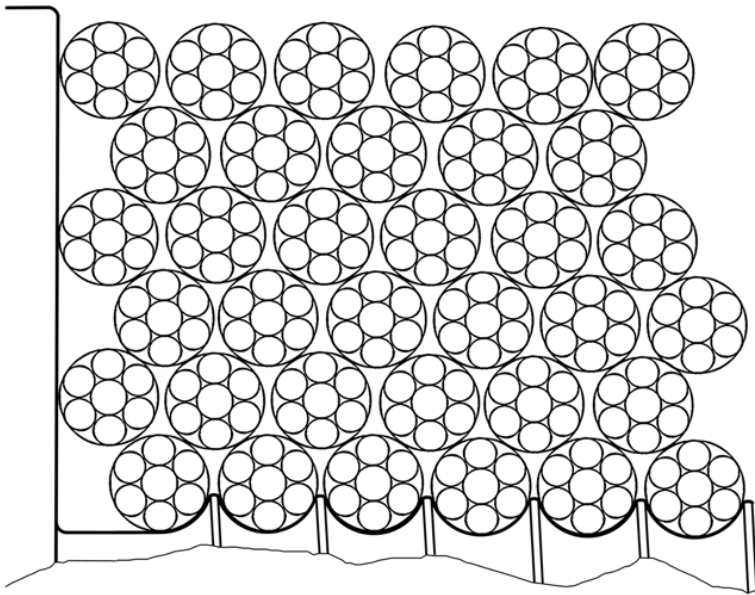
Multiple Layer Drum Damage



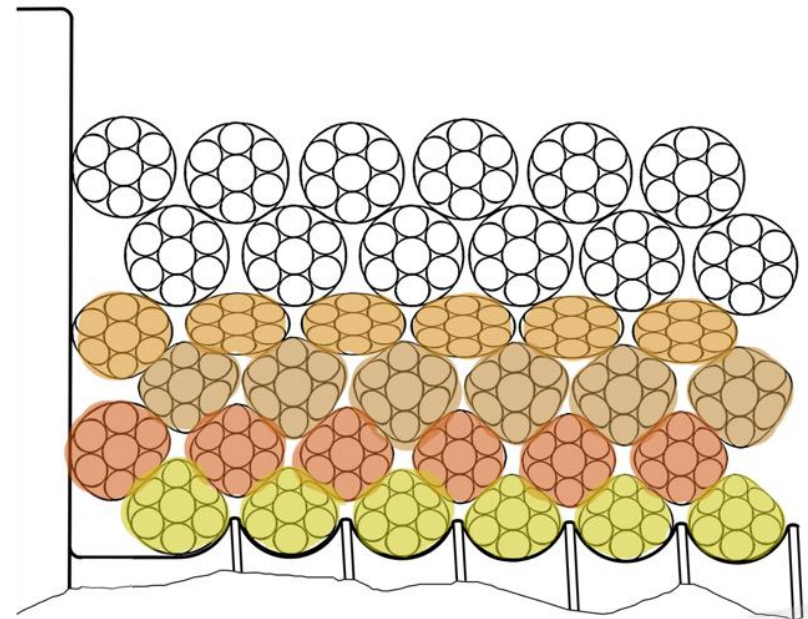
Lower layers have collapsed due to insufficient rope pre-tension.



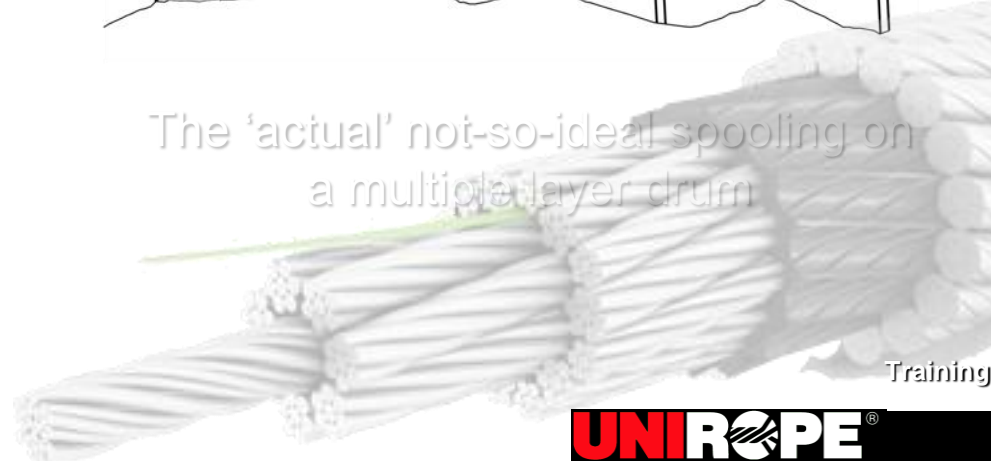
Multiple Layer Drum Damage



The 'theoretical' ideal spooling on a multiple layer drum



The 'actual' not-so-ideal spooling on a multiple layer drum



Multiple Layer Drum Damage



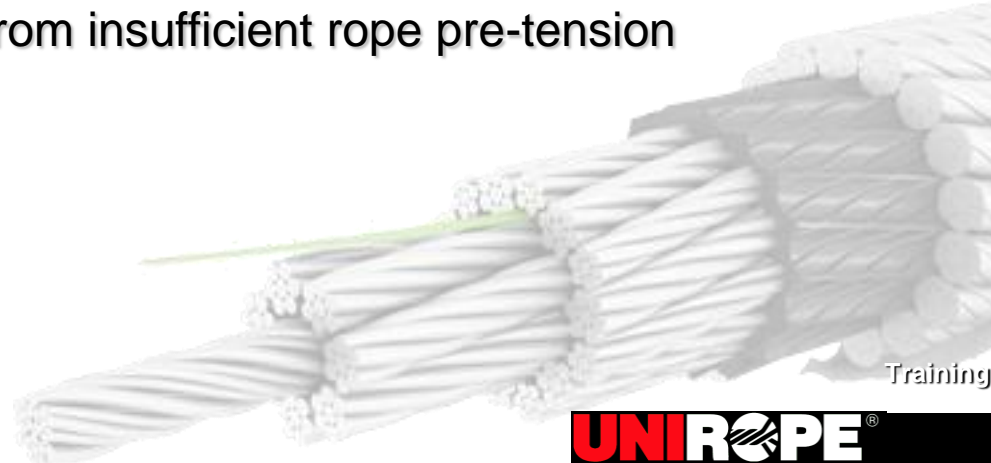
Damage to a boom hoist rope due to insufficient rope tension



Multiple Layer Drum Damage



Premature damage resulting from insufficient rope pre-tension



Multiple Layer Drum Damage



Damage to a boom hoist rope due to insufficient rope tension

Multi Layer Drum Damage

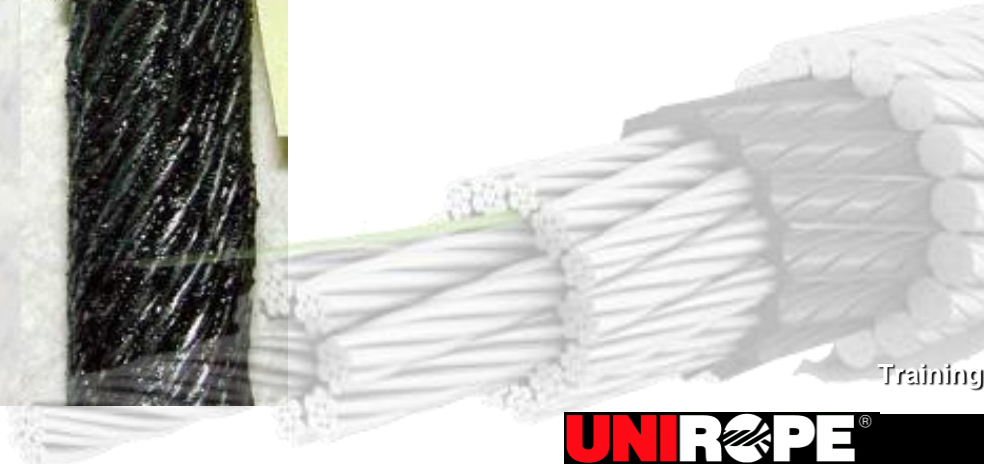


Typical multi-layer drum (on a tower crane)

Multiple Layer Drum Damage



Typical resulting
rope damage
(non-rotating)



Training

Multiple Layer Drum Damage

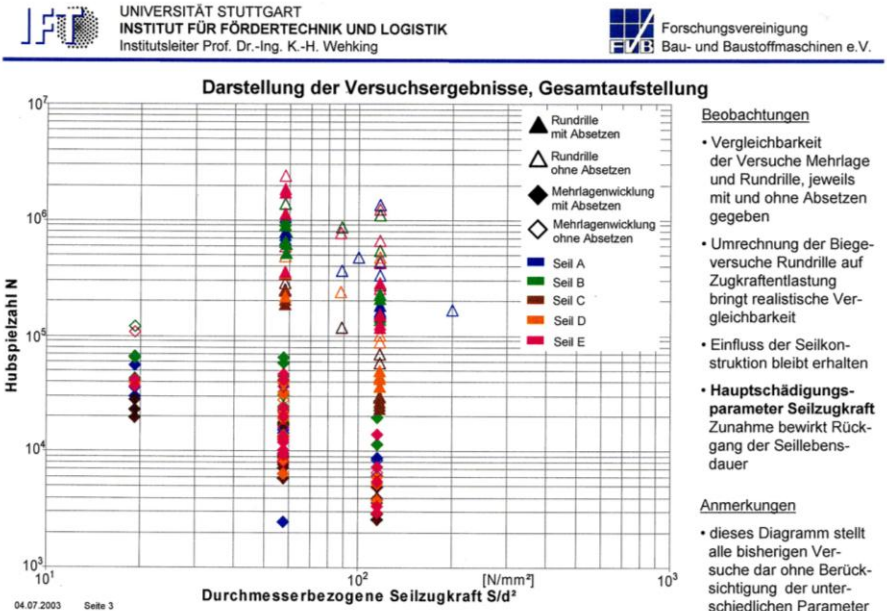
Results:

- Ropes on single layer drums had to be discarded because of FATIGUE.
- Ropes on MULTIPLE layer Drums had to be discarded because of abrasion and interlocking damage.

- 3) Difference in service life
 : at BEST was 12% of that of single layer drums
 : lowest was 2.6% of that of single layer drums.

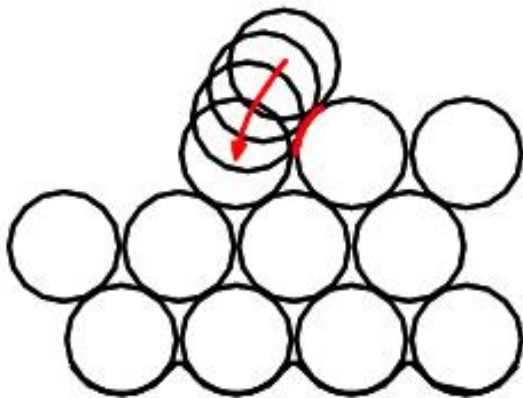
In other words: Wire Rope life time expectancy on SINGLE layer drums is about 38 to 8 times BETTER than on MULTIPLE layer drums.

That explains why we don't have to be concerned about the FATIGUE Life of ropes on MULTIPLE layer drums. Wire rope will get crushed to death !

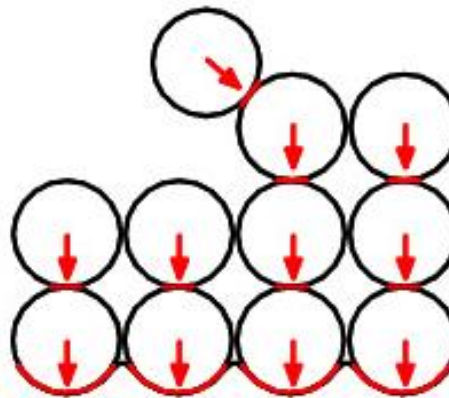


Multiple Layer Drum Damage

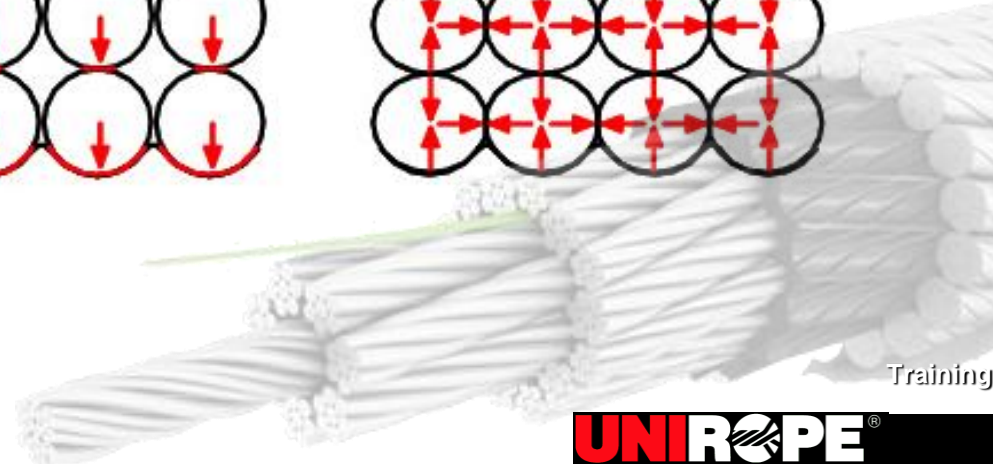
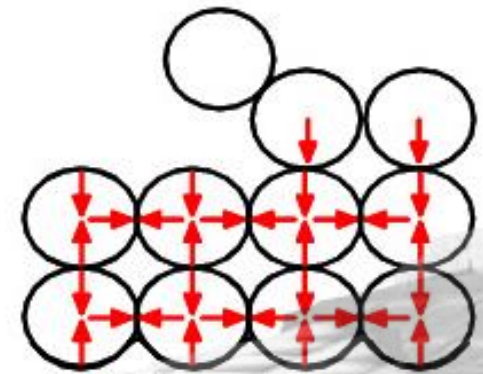
Rope damage caused by mechanical wear at the cross-over points



Damage caused by contact pressure



Damage caused by lateral deformation resulting in oval rope shape



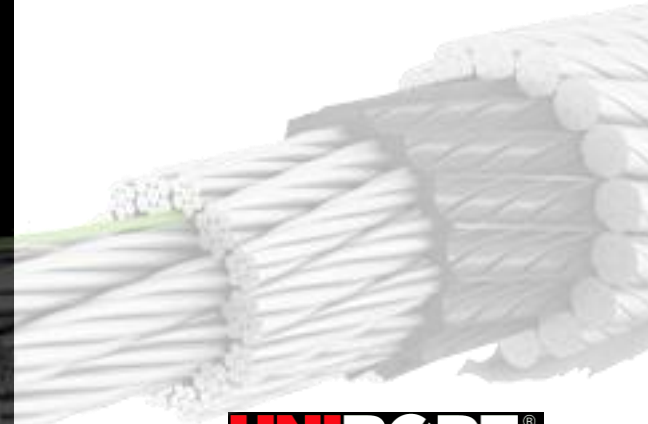
Multiple Layer Drum Damage



Damage to a boom hoist rope due to insufficient rope tension

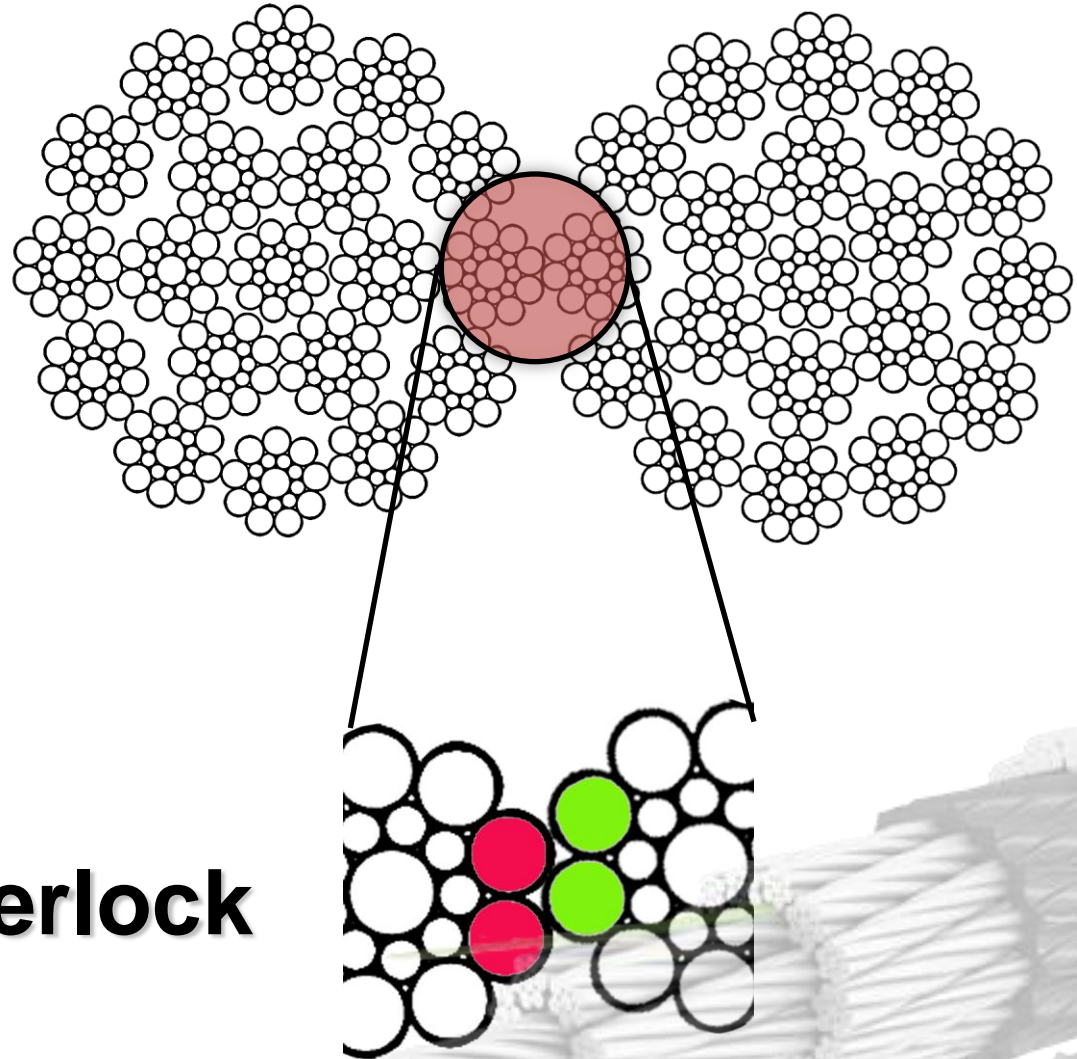
Multiple Layer Drum Damage

Resulting Damage from Rope Cross Over



Multiple Layer Drum Damage

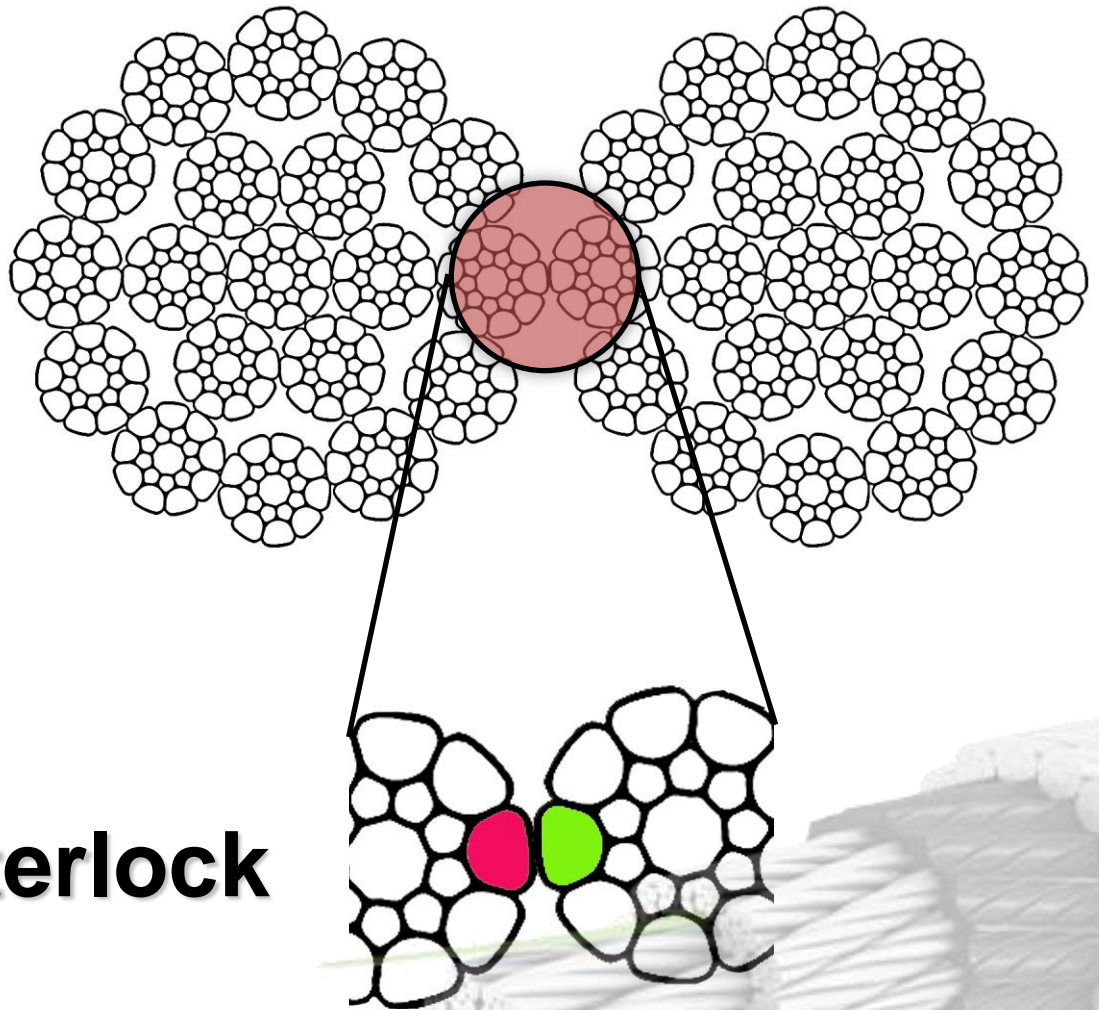
19 x 19



Severe interlock

Multiple Layer Drum Damage

19 x 19
Strand compacted



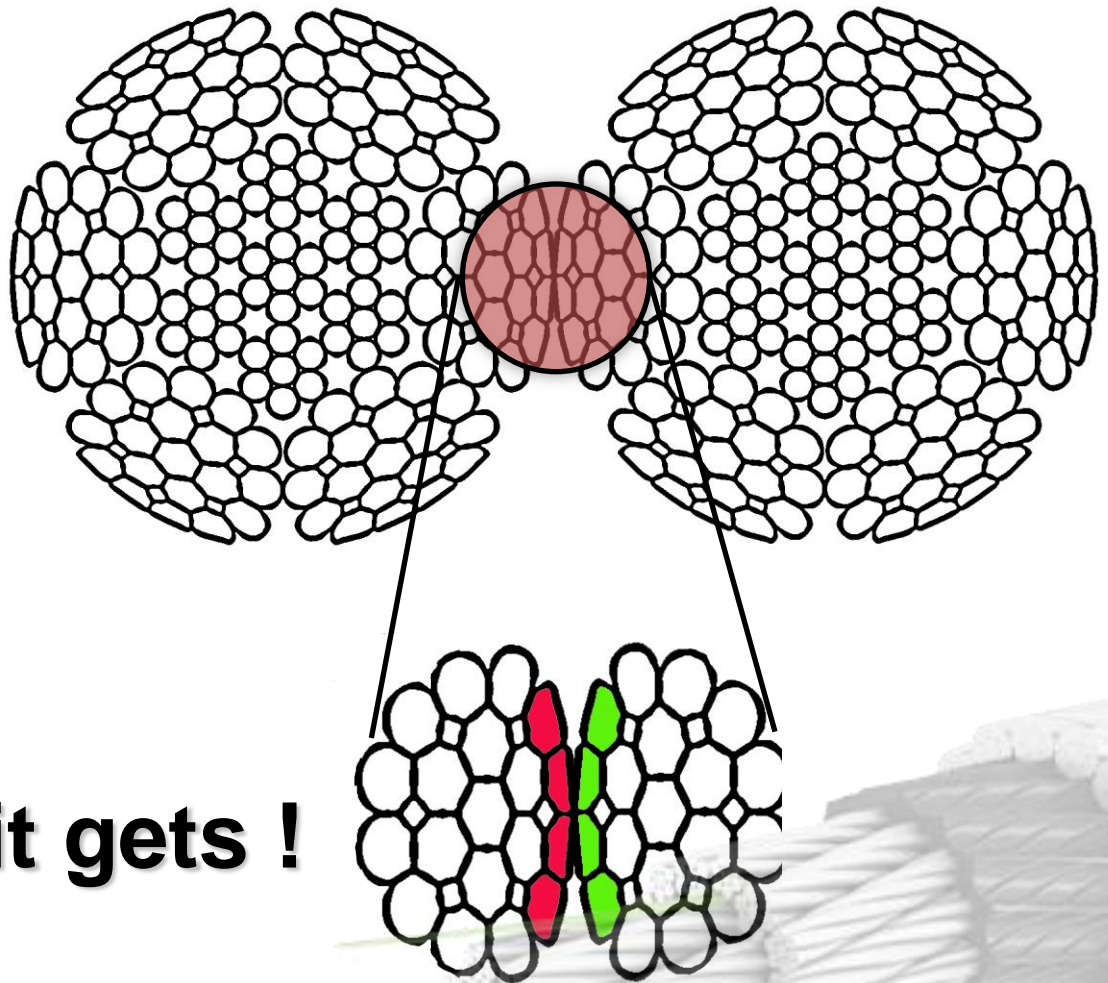
Less interlock

Multiple Layer Drum Damage

6-strand

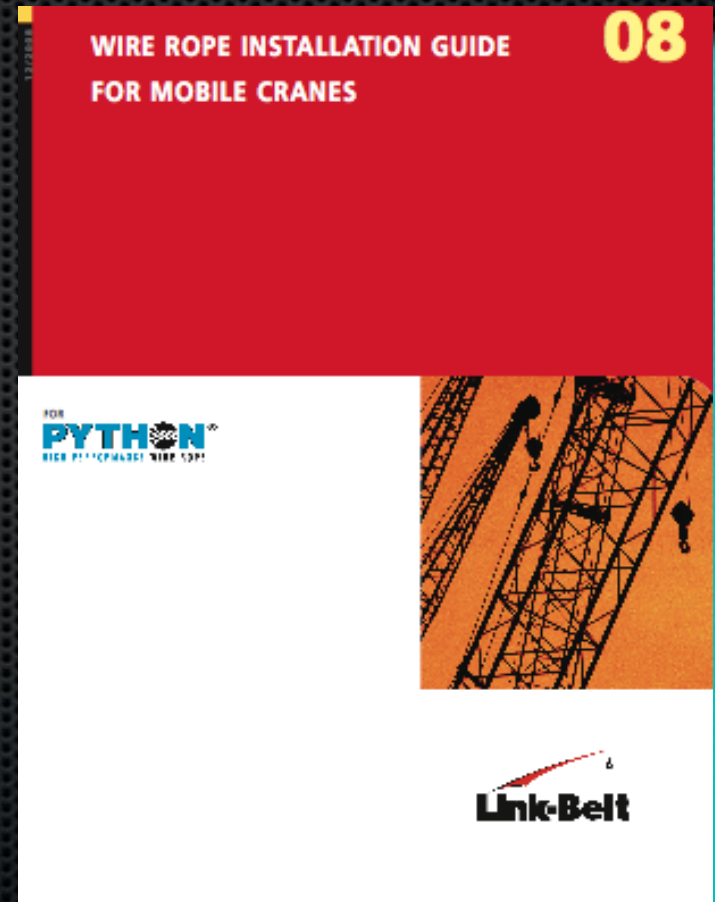
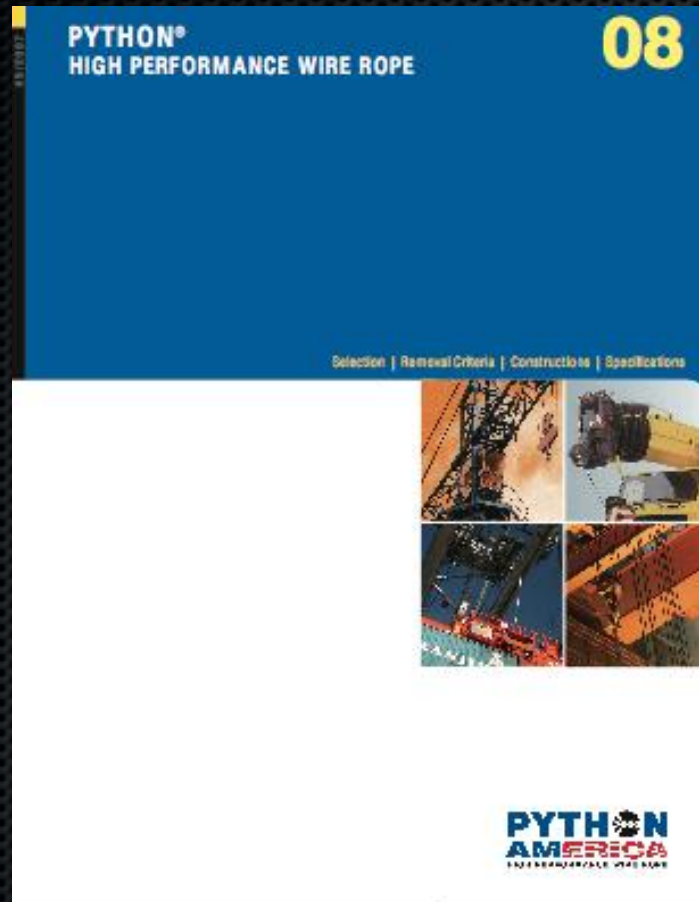
Swage compacted

**For Boom Hoist
on Mobile Cranes**



As good as it gets !

Additional Information



Basic Information

About the Safe Use of Wire Rope



Basic Information

About the Safe Use of Wire Rope

