IPH®

ELEVATOR ROPES

Installation & Maintenance

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The elevator is the most used form of transportation worldwide. As buildings around the world are reaching greater heights, the needs for safety and comfort are becoming increasingly important every day.

To ensure the elevator rope´s service life, IPH has put together a list of recommendations for installation and maintenance.

SUMMARY

IPH QUALITY

The quality certificate issued by IPH guarantees the traceability and conformity with national and international standards that can be applied to the controls carried out throughout the entire manufacturing process, from the production of wires to the final product.

MANAGEMENT SYSTEM CERTIFICATIONS:

American Petroleum institute, API Monogram Spec Q1, Spec 9A.

TÜV Rheinland, ISO 9001:2008.

Fundaçao Vanzolini NBR, ISO 9001:2008.

WIRE ROPES SPECIFIC CERTIFICATIONS:

Marine use:
Lloyd's Register plant certification.

Elevators:
IRAM-INTI and IRAM 840 product certification.

General purpose:
ABNT NBR and ISO 2408 product certification.

Offshore containers lifting slings:
DNV 2.7-1 product certification.

Wire rope slings:
IRAM 522 flemish eye product certification.

For further information regarding those certificates mentioned above, please visit our web-site.

WIRE ROPE INSTALLATION

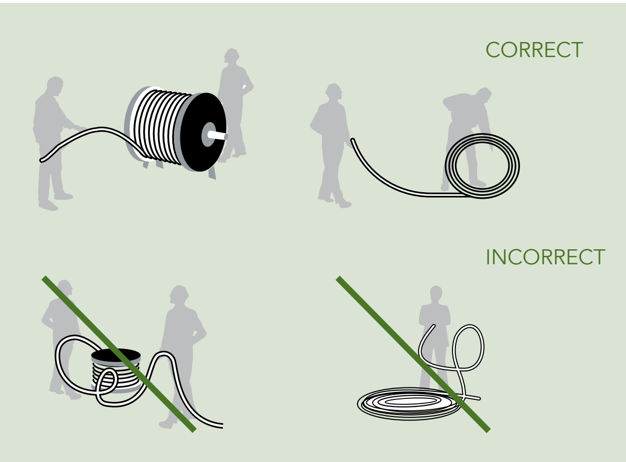
Before installation, ropes must be inspected to identify any area that may be damaged.

1.1 Storage

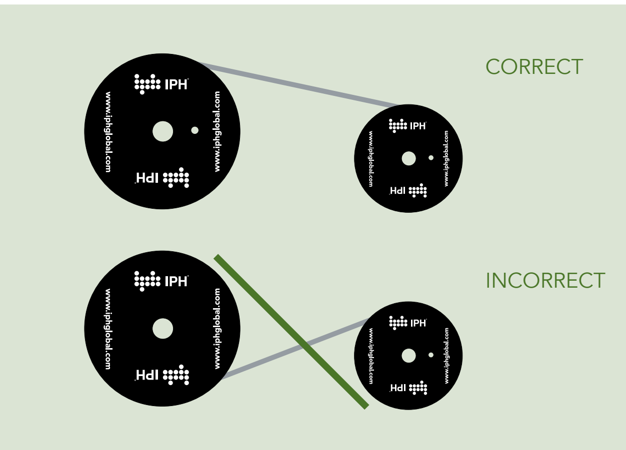
- Store the ropes in a well ventilated place free from dust, damp, chemicals or fire.
- Rotate the rope reel 180° every six months.
- Avoid direct contact of the steel wire rope with the ground.
- Examine the rope condition periodically, prevent from rust and external damage which are the most common issues.
- If the mentioned recommendations are followed, the rope could be stored for ten years.
- All these conditions should be considered especially with sisal core wire ropes. The sisal is an hygroscopic fiber and damp is its first enemy.

1.2 Handling

Ropes must be prevented from adding torsion during unwinding and installation.

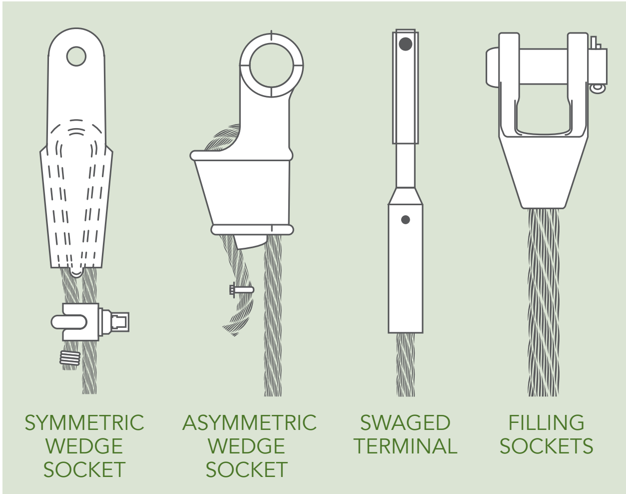


When transferring from a coil to the drive sheave avoid inducing a reverse bend into the rope.



1.3 End Terminations

Rope terminations regularly used in elevator installation.



1.4 Replacing Ropes on Existing Installations

Prior to rope replacement it is highly recommended to make an inspection of the sheaves grooves. All sheaves need to be inspected and checked from wear when changing ropes.
Re-groove or replace sheaves if necessary.

Example of wear defects on grooves.

Reference: Range of traction sheave hardness according to rope grade (Tensile strength of outer wires)

Minimum tensile grade Outer wires [N/ mm²]	Sheave hardness [HB]
1118	190-220
1370	200-230
1570	210-240
1670	220-250
1770	230-270
1960	240-280
2050	250-300

1.5 Rope Surface Line

IPH hoist ropes have a painted white line in order to aid the installers determining whether the ropes are twisted.

To check the number of twists, make a full up or down run of the elevator after rope installation and count the number of rotations of the surface line. The number of twists per 100 feet (30 meters) must not exceed:

Wire ropes with 1:1 roping = 1.5
Wire ropes with 2:1 roping = 3.0

1.6 Tension Equalization

Rope tension is a very important maintenance factor in extending rope and sheave life, and also improving the quality of the ride.

A set of ropes is considered to be equally tensioned when the variation of the tension measured is within 10%. Rope tensioning should be re-checked after 4-6 weeks, after 6 month and then annually.

It is also important that the necessary adjustments are made by shortening the loose ropes and not by twisting or unwinding the end of the rope, this could damage the rope easily.

NOTE: If a rope has an estrange tension deviation from others make a close follow up and if the problem persists, a rope change should be considered.

If proper equalization of the rope tension cannot be maintained after six months, the entire set of hoist ropes shall be replaced.

NOTE: Before replacing the set of ropes, check the possible causes of unequal tension described on 1.6.1.

1.6.1 Causes of Unequal Rope Tension

- Human error during installation.
- Initial inequality in diameters of sheave grooves.
- Wear of grooves and sheaves caused mainly by slippage of wire ropes.
- Variation in rope diameter.
- Uneven rope lubrication.

1.6.2 Consequences of Unequal Rope Tension

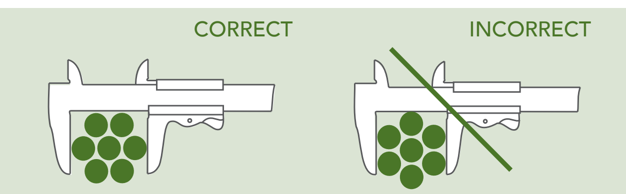
- An unbalanced line can reduce the rope service life.
- Vibration and noises are produced during the trip.
- Uneven tension produces different degrees of contact pressure on the grooves causing slippage.
- The slippage of the rope and the imperfect balance of cars make difficult to control starts and stops.

WIRE ROPE INSPECTION

IPH recommends wire rope inspections every six months. Factors such as working environment, number of trips, maintenance program should be taken into account during these activities.

2.1 Wire Rope Diameter

Always measure the diameter and ovality on rope in the worst condition. Rope diameter measurements should be taken from a straight portion of rope at two points spaced at least 3 ft apart. At each position, two measurements, at right angles of the circumscribed circle diameter, shall be taken.
Tolerance and variation in diameter (ovality) according to ASME A17.6.
Diameter reduction:
Replacement should be considered if the diameter is reduced by 6 % of the nominal rope diameter.

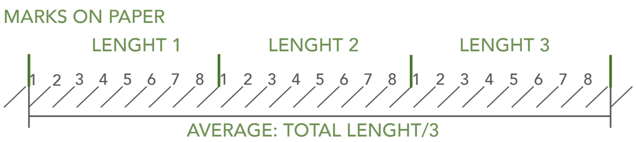


Rd(%)= (nd-ad)/nd x 100
Where: Rd(%): Reduction in diameter nd: Nominal diameter [inches] ad: Actual diameter [inches]

2.2 Lay Length

Lay a section of paper on the wire rope and mark the crowns. Depending on the number of outer strands, the number of crowns to be measured will change.

The procedure must be repeated for all the ropes. Make sure you mark off at least 3 lay lengths on each rope. Then calculate the average (Average = Total length/3). Record this information and note if the lay length of one or more ropes is considerably different than the other ropes. An increase in the lay length is related to a diameter reduction and degradation of the core of the rope.



Example of lay length measure for a 8 strands wire rope.

DISCARD CRITERIA FOR ELEVATORS ROPES

Elevator ropes are usually discarded because of broken wires and wear, but other factors, such as diameter reduction, local damage caused by metallic edges or deformations, waviness, corrosion rouge or excessive stretch, may also give reasons to discard.

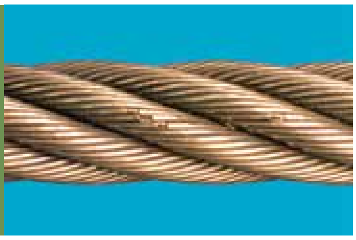
A skilled person should consider all these factors when carrying out a thorough examination in order to decide whether a set of ropes should be discarded.

Even if only one rope has reached the discard criteria, the whole set should be replaced.

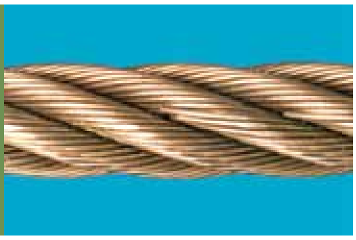
3.1 Broken Wires

It is possible to distinguish two kinds of wire breaks:

Crown Breaks:
Fatigue failure of the outer wire following a diameter reduction due to wear.



Valley Breaks:
Wire breaks that are visible and occur outside of the crown wear area with the crown wire intact.



The following chart indicates the number of visible broken wires in the worst section of the rope for different construction where replacement should take place.

Wire Breaks Crown Wire Breaks Per Lay Lenght			
6-Strand Rope Applications			
	Normal Wear Conditions	Unfavorable Wear Conditions	Ropes Showing Rouge
Distributed breaks (max.)	24	12	12
Unequal breaks (max.)	8	4	4
4 Side-by-Side Breaks	12	6	6
8- and 9- Strand Rope Applications			
	Normal Wear Conditions	Unfavorable Wear Conditions	Ropes Showing Rouge
Distributed breaks (max.)	32	16	16
Unequal breaks (max.)	10	5	5
4 Side-by-Side Breaks	16	8	8

Chart according to ASME A17.6 (Replacement Criteria)

Replacement should take place when:

1. The broken crown wires are randomly distributed among the strands and the number of broken wires per rope lay in the worst section of rope exceeds the values shown in "Normal Wear Conditions".

2. The distribution of breaks is unequal, predominating broken crown wires in one or two strands, and the number of broken wires per rope lay in the worst section of rope exceeds the values shown in the "Normal Wear Conditions".

3. There are four adjacent broken wires in any strand and the number of broken wires per rope lay in the worst section of rope exceeds the values shown in "Normal Wear Conditions".

4. Excessive wear, unequal tension, poor sheave grooves and any other unfavorable condition affect considerably the wire rope. For those cases the criteria for broken wires shall be the values indicated in the "Unfavorable Wear Conditions".

5. Red dust or rouge exists and the number of broken wires per rope lay in the worst section of rope exceeds the values shown in "Rope Showing Rouge".

6. There are more than one valley break per rope lay.

7. There are any valley breaks at any location where rouge exists.

3.2 Diameter Reduction

Replacement should be considered if the diameter is reduced by 6 % of the nominal rope diameter.

3.3 Corrosion

When moisture is introduced to a metal surface, it rusts. But rouge is different from rust. It does not indicate that a wire rope is beginning to rust. Rouging means that abrasion is present in the wires of the rope.

The pressures of the system while working generate very small particles around the metal surface and they begin to rust.

Rouging is generally due to a lack of lubrication. Field lubrication does not restore the rope to its initial condition. Any damage has already been done.

Rouging detection is important, due to it reduces the number of allowable wire breaks. (See chart above according to ASME A17.6, Replacement Criteria)

WIRE ROPE LUBRICATION

Steel wire ropes are made of a number of moving parts. For example, an 8x19 construction wire rope is formed by 152 wires that are grouped into 8 strands. Both the wires and strands are subjected to tension and bending, which cause wear between them and against sheaves.

All parts of the wire rope should be kept lubricated to avoid excessive heat due to friction. During steel wire ropes manufacturing, wires and strands are lubricated. A new manufactured wire rope contains about 1.2% by weight of lubricant.

As the wire rope in operation rises in number of cycles, it exudes lubricant to its surface. Experimentally, a steel wire rope loses about 0.12% by weight of lubricant every 100,000 cycles. Re-lubrication is necessary to work under optimal conditions and extend the life of the wire ropes and sheaves.

A periodic inspection plan must be performed. A small annual investment in lubricant saves a great expense arising from the anticipated replacement of wire ropes and sheaves.

4.1 Inspections

The frequency of re-lubrication depends strongly on environmental and installation conditions. Such as temperature, moisture, lift speed and rope pressure. Due to those critical conditions, an increase in the inspections frequency is advisable.

Field lubrication of the elevator rope is necessary when the rope has become dry to the touch or at least once a year.

4.2 Content of Lubricant

It is important to know the right amount of lubricant that a wire rope should have. A lower amount of lubricant causes an increase of temperature, an excessive wear in wires and an increase of rouging.

On the other hand an excess of lubricant must be avoided, because it causes ropes slippage on sheaves, an undesirable effect that can be seen on the drive sheaves during acceleration and deceleration.

The lubricant application could be carried out by means of an automatic device or manually, both methods are acceptable.

As a reference, if you are performing annual re-lubrication, we suggest adding lubricant according to the following table:

Rope diameter	Quantity of lub per 100 ft of hoist rope
[inches]	[ounces/100 ft]
3/8	1.0
1/2	1.5
5/8	2.0
11/16	2.3
3/4	2.5
7/8	2.8
1	3.0

NOTE: If the rope is completely dry to the touch, duplicate these values.

The addition of lubricant should be performed in a distributed manner. If re-lubrication is only locally, some areas of the ropes may be working dry while others may have an excess of lubricant.

4.3 Notes

IPH recommends Funilub® for elevator ropes.

Never use solvents to clean elevator ropes. Most of the solvents dilute the lubricant within the strands of the elevator hoist rope.

Do not re-lubricate the governor rope. The lubricant can interfere between the rope and the drive sheave causing slippage and a malfunction of the safety system.

Regarding to lubrication, natural fiber core ropes are advantageous over steel core ropes. As natural fiber retains more lubricant than steel (10-15% by weight), natural fiber core serves as self lubricating. When operating, the strands compact the fiber core and this pressure begins to release lubricant which is beneficial for the operation of the system.

IPH VALUE

1. Detailed and strict process control that includes:

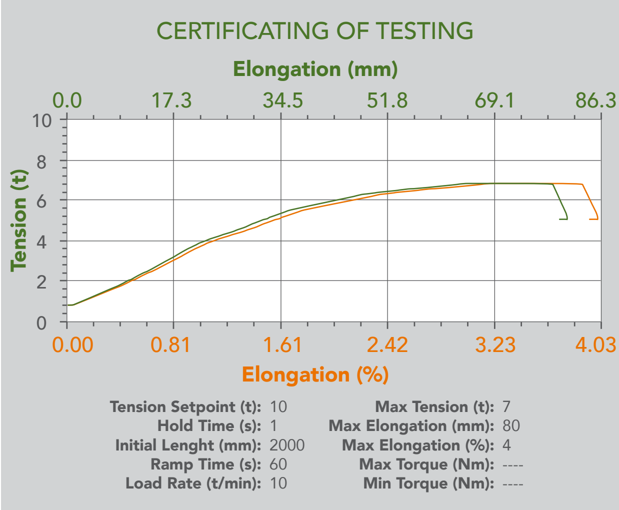
   - Metallographic properties (grain size, metallographic structure, inclusions, segregation).
   - Mechanical properties (tensile strength, hardness, ductility, bending fatigue, stretch, torsion).
   - Chemical properties (chemical composition, coating control, lubricant content).
   - Dimensional properties (diameter, ovalization, density, length, mass, helix preforming).

   On:
   - Raw material
   - Patented wire
   - Drawn wire
   - Strand
   - Sisal core
   - Rope

2. Traceability and certification.
3. Customized engineering design.
4. Skilled staff.
5. Customer advice.

TENSILE STRENGTH / ELONGATION TESTS

In tensile strength test benches, diameter reduction under load and elongation is monitored.



DIMENSIONAL

Dimensional controls are carried out during the whole manufacturing process assuring diameter regularity.

FATIGUE TESTS

Fatigue tests simulate real working conditions, which allow monitoring the quality of our ropes at all times.

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