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Wet Ropes Equal Dead Ropes

Occasionally we will be asked if "just a little water can hurt an elevator rope?" The truth is—**water kills elevator ropes**. Admittedly there is no definitive hard and fast rule as to how long the process will take. But rest assured that the lifespan of any elevator rope—hoist, compensation or governor—when exposed to moisture *(be it condensation, flooding, or a dowsing from a sprinkler system or broken water pipe)* will be drastically shortened and that overall product and system performance will decline.

Though elevator ropes are more advanced than ever they still remain vulnerable to the destructive effects of moisture. And to explain why one must examine the very nature of the 'bright' *(uncoated)* wires that go into an elevator rope's own construction.

What Goes Into An Elevator Rope

To make our explanation of why moisture and wire ropes will always be mortal adversaries easy to comprehend let us first offer a little basic background on ropes.

Elevator ropes *(hoist, comp and governor ropes)* are composed of a core surrounded by wire strands, which in turn are sometimes encased in another set of strands of wire. This basic construction *(see figures 1 and 2)* remains constant no matter whether the core is made of Natural Fiber *(Sisal)*, Synthetic Fiber *(Polypropylene)* or IWRC *(Independent Wire Rope Cores)*, and regardless of rope type.

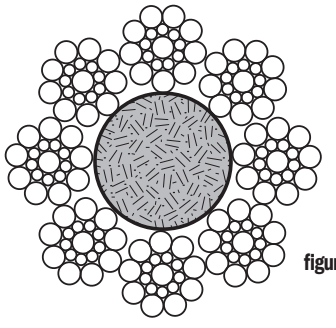


figure 1

8 x 19 Seale — NFC/SFC

The most common variety of elevator rope is old-fashioned Standard Sisal 8 x 19 Seale construction (Natural Fiber Core in figure 1). Such a rope is especially susceptible to the effects of moisture and humidity. One should remember that while all rope cores are not equally affected by direct contact with water (seen in figure 2), all are susceptible to rouge and rust despite internal lubrication provided during manufacture.

The core's key function is to act as a central support member and keep the strands separated. In addition the core is designed to serve as a flexible base for the strands during rope operation. A good quality core helps keep the elevator rope round under the various loads and pressures that a rope will experience during its lifetime.

The outer strands of wire act as a contact surface with mechanical components within the installation *(primarily main drive and deflector sheaves)* and helps provide traction for system performance.

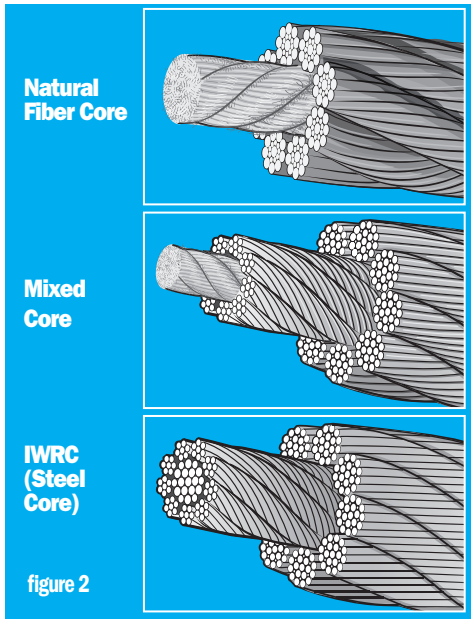


figure 2

Unfortunately some industry professionals tend to overlook a third component of rope construction because it seems to be an afterthought—lubricant. However the lubricant applied to a rope during manufacture is more than a quick pouring of smelly grease. Lubricant is a low-viscosity protective covering for the core and strands that allows the inner core and outer strands to work together both optimizing rope life and minimizing internal friction. **In a Sisal Core rope lubricant is critical in preventing the degradation of the natural fibers and can compose between 10-15% of the core's total weight.** Regardless of the core used lubricant is critical to overall rope performance as it can help increase rope traction, acts as a barrier to rust formation and offers some corrosion protection to the outer wires as well.

Myths Behind Lubricant

Some mistakenly assume that a Sisal Core rope will naturally wick lubricant throughout its total length, and that the original amount applied in the factory will be sufficient to last through its entire life. While Sisal Core fibers will wick lubricant somewhat, sisal fibers are not continuous strands that provide a pathway for the free movement of lubricant.

Additionally there is no way for any manufacturer to foresee how much lubricant any particular rope would require throughout its lifetime *(system needs, actual usage, maintenance demands and environmental conditions within the hoistway create too many factors to calculate)* so the idea that one application of lube prior to installation would be sufficient for the life of a rope is hardly realistic.

And while lubricants can vary in formulation and some have been shown to impact rope life expectancy positively, no rope lubricant can provide absolute protection against moisture itself. This can lead to rouging and rusting in both IWRC and Mixed Core ropes, and total core degradation in Sisal Core ropes *(which is a fancy way of saying, 'rot')*. **In truth, once a rope gets wet an elevator rope is on the fast track to rope death—there's no preventing it.**

Water Entry: How Moisture Gets Into The Rope Core

No matter if the rope is SFC, IWRC or NFC, water can enter its interstices *(between the wires and strand areas where lubricant may not have penetrated)* via the process of natural capillary action *(called 'wicking')*. However NFC ropes are more susceptible to this due to the natural quality of sisal fiber to absorb moisture.

Naturally we do all that we can to try to limit this tendency. Even soaking the sisal yarn in vats of heated lubricant in order to displace the moisture within and replace it with solution to preserve and protect the fibers.

Indeed the inherent limitations of natural sisal fibers ***(even 'perfect' fibers)*** because of moisture absorption has been one of the key reasons why we have advocated for an industry-wide switch from old-fashioned sisal core ropes to newer synthetic core varieties of rope. All NFC ropes are especially vulnerable to water intrusion *(even condensation)* as moisture will naturally force any previously applied internal lubricant out of the fibers.

Remember that while a rope appears to be a solid single unit it is in fact a stranded union of components whose parts are nestled within each other. No matter how tightly packed there will always be tiny gaps *(in fact this is the key to a rope's flexibility)* between rope elements. Regardless of any other benefit that lubricant provides, its main function is to encapsulate those components and fill the open spaces within the rope.

Sources Of Moisture

Even ropes that are not exposed to the effects of flooding in the pit, dowsed by fire extinguishers or sprayed by malfunctioning water sprinklers are subject to the devastating effects of moisture. An elevator hoistway is not an environmentally static place. Summers in the American Southeast and Gulf states are renowned for being equally hot and extremely humid. Maintenance personnel know how little time it takes for sisal cores to absorb surrounding humidity, degrade, and require replacement.

Another overlooked form of moisture in the hoistway is simple condensation. Any rope hanging in a hot environment is naturally under the influence of heat and natural humidity. As ropes cycle above to a cooler air-conditioned machine room condensation can form rapidly on the rope surface.

Condensation build-up can become even more pronounced if the ropes are not in constant motion. This lack of movement will allow lengths of ropes to become even more saturated than others, which can lead to condensation wicking throughout the rope.

Even if an elevator rope is not exposed to severe temperature changes condensation can form on ropes due to the movement of air within the hoistway as it circulates air from the surrounding structure.

An elevator car will pull and push air up and down the hoistway *(creating air pressure differences)* and, to a degree, drag air through the lift doors themselves. This can create a rope environment that is prone to the buildup of condensation. As with the effects of humidity, Sisal Core ropes affected in this fashion will degrade.

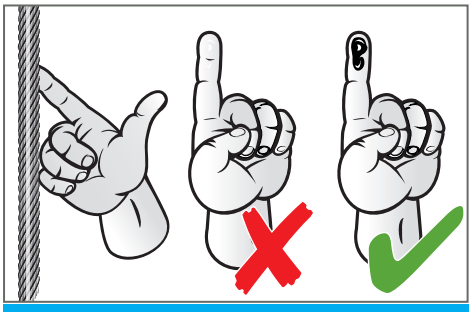
No matter whether the moisture is introduced via humidity or condensation the impact on Mixed Core and IWRC ropes is equally dire because it exposes them to the effects of rouging or rust.

Can Lubrication Applied After Manufacture Prevent Further Moisture Entry?

Tough question– but we have to say no. Naturally we strongly recommend re-lubrication after initial rope installation and that it be performed once per year or upon every 250,000 cycles afterwards. We even offer lubrication guidelines ***(consult your Brugg representative or go online for more details)*** and provide rope lubricant and an applicator for the job as well.

However re-lubrication has almost no overall impact on water ingress after moisture is already inside the rope. The key goal behind re-lubrication in the field is to reduce friction between rope elements *(core and wire strands)*, to diminish the impact of rope wear on the sheave *(and vice versa)*, and to shield the rope against further moisture intrusion.

Certainly the potential benefits of lubrication in lessening the impact of rope rouge and rust are well documented. **However when it comes to rope exposed to moisture we agree with other professionals — adding lubricant after the fact cannot expel this water. At that point it's time to re-rope entirely.**



One rule to remember is if the ropes are dry to the touch then you should lubricate them immediately. It is essential that ropes are 'clean' (free from debris and caked lubricant) prior to lubrication and lubricated a minimum of once a year— or every 250,000 cycles (starts/trips). Never apply solvents to sisal core ropes as they can remove manufacturer lubricant and destroy the rope core.

Over-Lubrication Doesn't Impact Ropes As Simple Humidity Does

Lubricant cannot impact Sisal Core *(or any other type of core)* Ropes as humidity or condensation can. This is because sisal absorbs the moisture within and causes the fibers to swell against the outer wire strands *(figure 3)*, whereas lubricant simply encases fibers and fills the areas between wire strands and rope core.

Certainly over-lubrication can create a mess as extra amounts on the rope surface can be thrown off on the machine room floor or ceiling as it goes around the drive sheave. And too much lubricant on ropes can result in a loss of traction ***(which can lead to an overall reduction in system performance)***.

Overly lubricated ropes are also prime areas for buildup of dust, debris and airborne dirt. Indeed the build-up of lubricant on governor rope surfaces *(though this is due to the internal lubricant 'weeping' out of the rope itself)* leads to a condition called **"dirty ropes"**, which can only be controlled by switching from Natural Fiber ropes to ropes featuring synthetic fibers.

Moisture's Effect On Sisal Core Rope Length and Rope Diameter

As previously stated, extremely humid summers can cause Sisal Core ropes to absorb the humidity from the surrounding air. This humidity will cause the core to expand and thus bulge out against the surrounding outer wire strands. Consequently this will result in a natural increase in rope diameter and an observable decrease in rope length.

This enlarged condition can become especially pronounced in governor ropes as they cannot be field lubricated *(code requirement)*. This effect of expansion and rope shortening can even lift the governor tension sheave as well. Though this condition can also impact compensation ropes, it is less prevalent due to the fact that compensation ropes can be lubricated in the field.

Direct Contact With Water: The Problems You Face

While current ASME code does not specify what to do with water-saturated rope, ASME A17.6-2010, 1.10.1.2 does specifically detail replacement criteria under the heading of "Unfavorable Wear Conditions" for ropes that show evidence of rouge. Regardless, direct immersion by ropes into water should bring to mind these key points.

Wet ropes are going to be permanently damaged and will have a drastically shortened lifespan. No method or application that could potentially reduce the corrosive effects of humidity or condensation on an elevator rope can restore a hoist rope to its original state or prolong its life.

Even if only one segment of a rope was in direct contact with water that one instance can damage the rest of the rope. In Sisal Core ropes moisture will wick through the remainder of the rope as car motion and gravity accelerate the biodegradation of the core. Mixed and IWRC ropes will wick water along the wire strands which will accelerate rouging within the rope. And any presence of water on the rope surface *(unless the wires used are galvanized)* will cause the bright wires to rust.

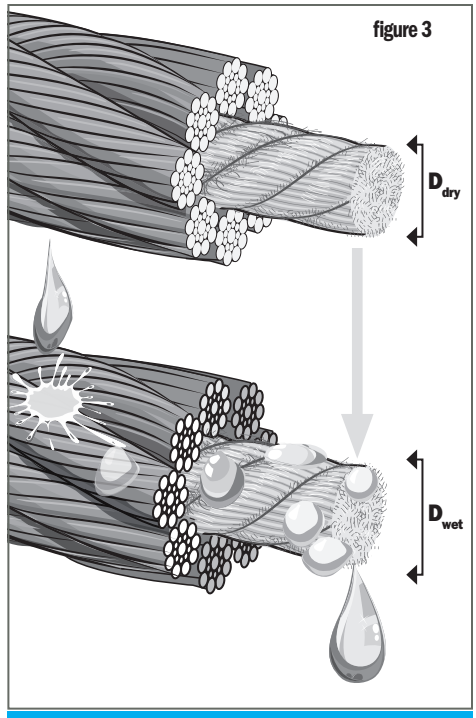
Wet conditions will cause NFC ropes to expand in diameter and shorten in length which will lift governor and compensation sheaves. Though this lifting can sometimes remedy itself *(as ropes under dry conditions and load will lengthen)* it is not a certain process and therefore can impact ride, performance and car leveling.

Ropes exposed to water can expand beyond their nominal diameter making them a bad fit for the drive sheave. Any change in rope diameter can cause the rope to slide in a sheave groove and seriously damage the drive sheave. In addition to the cost of re-grooving or replacing the sheave, degraded sheave grooves will impact every new set of replacement ropes afterwards decreasing performance and shortening their life span.

Wet elevator ropes should be replaced as soon as one suspects they have been affected by water. Even if evidence of a problem is not immediately apparent there is no choice. The potential for damage to the system and the potential threat of injury to all is too great to risk.

We have heard that ropes subject to water damage due to flood or faulty sprinklers may sometimes be covered by insurance compensation. However most policies that do so place a time limit between the time of incident and the reported time of discovery. And policies concerning ropes contaminated due fire-related damage vary considerably.

figure 3



Exposure to condensation, moisture, or direct immersion in water will impact NFC ropes dramatically (as seen in a comparison between rope diameters in their dry and moistened states) and cause rope cores to expand and press out against the surrounding outer wire strands. This will increase overall hoist rope diameter, shorten rope length and produce a rope that can abrade and damage the inner sheave groove surface. At this stage even re-lubricating the ropes will have little effect. The only serious alternative is to replace the rope (preferably with one that offers long-term cost savings and better performance potential, as with Mixed Core or IWRC ropes).

Signs Of Moisture Damage

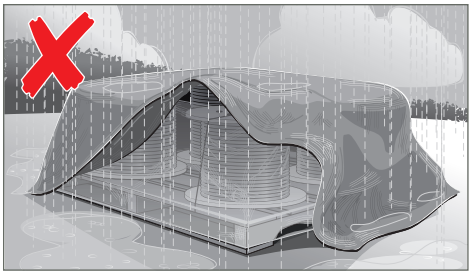
Rouging

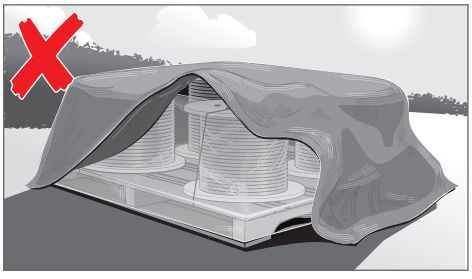
Rouging *(figure 5)* appears as fine red oxide dust upon the surface of a wire rope, which causes many to mistake the condition for rust. The fine red dust starts on the inside of the rope and indicates that the inner sisal core is losing its strength and can no longer support its outer strands. This internal collapse causes the steel strands to rub against each other and grind loose small particles of metal that eventually work their way to the rope surface and then rust.

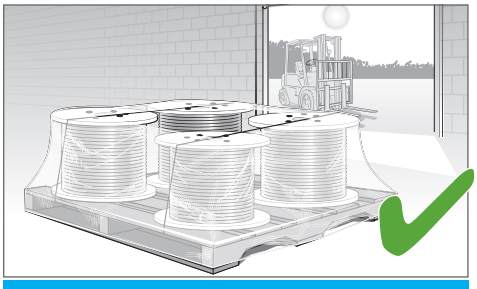
Rouging can also be found in elevator ropes that are subject to heavy loads and high vibrations as such conditions can work lubricant out of a rope.

Note: Field lubrication can only retard further damage in Mixed Core and IWRC ropes—IT CANNOT

figure 4

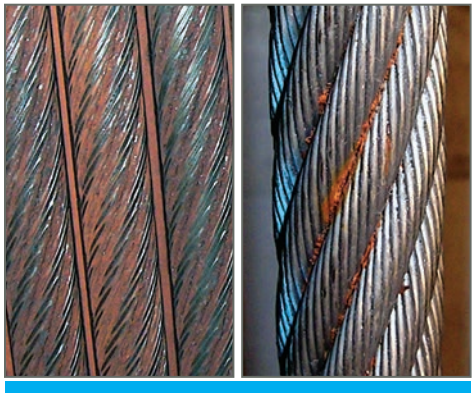






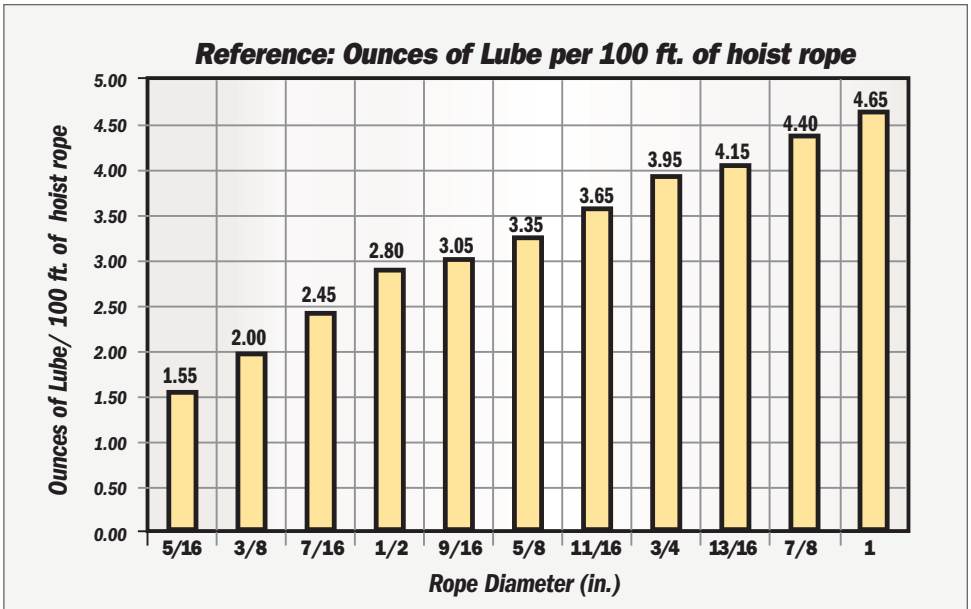
Storage plays a key roll in rope life. Never leave rope accessible to moisture, or where sunlight and heat may permit lubricant to flow out of the rope. Place pallets away from the elements and avoid contamination with worksite dust and debris.

figure 5 figure 6



Rouging (figure 5) is caused by the entry of moisture into the rope and indicates an internal collapse of the core is underway. As the core degrades it allows individual wires to rub against each other. This friction creates steel particles that work themselves to the outer rope surface. The end result is a fine red dust that covers the rope, sheave and surrounding workroom surfaces.

Rust (figure 6) indicates the presence of moisture and can appear as a crust on exterior rope strands. While re-lubrication can in some cases retard further damage, it cannot restore rouged or rusted rope to its original state.



A useful guide to the proper amount of lubricant for a variety of rope diameters.

BRING THOSE ELEVATOR ROPES BACK TO THEIR ORIGINAL STATE. No field lubrication can help restore Natural Fiber Core ropes or slow their decay should they show rouging.

Rust

Rust *(figure 6)* is a sure external indication of the presence of moisture in the hoistway environment. Such external corrosion will diminish rope breaking strength by reducing the metallic cross sectional area and accelerate fatigue wire breaks by creating surface irregularities.

Severe rust on IWRC and Mixed Core ropes should also raise concerns of the presence of internal rust *(which cannot be directly seen)* as it is an indication that the lubrication that fills the inner surfaces between wire strands and the core has been breached.

Good Storage Is A Key To Preventing Moisture Damage

The images provided *(above in figure 4)* are a helpful reminder of how ropes should be handled on the jobsite —**CAREFULLY**. **Outside storage IS NOT recommended! Precautions must be taken to prevent elevator rope from being exposed to the outside environment in order to preserve the rope's original lubricant and protect its condition.**

In addition ropes should not be exposed to dust and construction area debris as this can mix with lubricant and contaminate the rope and wire surfaces.

Often we find that what some describe as spots of excess lubricant on a rope surface is actuality a mixture of lube and worksite contaminants. **Placing a dirty rope onto a clean sheave is creating a problem that will never go away. Don't do it.**

Conclusion

To answer the original question posed—***"Yes, a little water can hurt a wire rope."*** And this moisture can come in any form— from flood, dowsing, condensation, simple touch, or just a humid summer breeze. To minimize moisture damage you should always follow manufacturer recommendations on lubrication *(avoid over-lubrication)* and if possible use High Performance *(Mixed Core or IWRC)* ropes.

However the best way to prevent moisture from affecting ropes is vigilance and addressing environmental conditions as quickly as possible after a problem is found. **SIMPLY PUT: WATER AND WIRE ROPES DO NOT GET ALONG AT ALL.**

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