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AN INDUSTRY ON THE RISE IS PLACING SKY-HIGH DEMANDS ON TODAY'S ROPES.

Ever since the very beginning man has sought to build edifices that would pierce the clouds and stretch the limits of his engineering capability. For nearly four millennia the Great Pyramid of Giza had held the distinction of being the tallest building in the world. Though it would keep that title until the rise of the Eiffel Tower in 1889, it was basically little more than a giant mound of stone blocks built to serve as a gigantic burial marker *(though erected with a measure of accuracy that would be the envy of any modern architect)*. Though the ancients built it to touch the sky, it cannot be considered to be a "skyscraper" in the modern sense.

Since the early 20th Century the world has watched with amazement as glass and steel structures have grown in scale and complexity. Indeed these incredible buildings have been erected with such frequency that the idea of skyscrapers, rising even higher, seems natural. Their presence in the modern cityscape has become so commonplace that they hardly attract headlines anymore in the world press.

Yet for those who must find ways to swiftly and efficiently transport the teeming masses of people who use such buildings as hubs for business, residences and entertainment centers, the challenges presented by them are especially daunting. And this is no less so for hoist rope manufacturers who must construct the basic traction element that, in essence, makes skyscrapers possible at all.

Vertical Highways In the Sky

Can hoist ropes keep up with the challenge of tomorrow's elevators?

The use of advanced techniques, materials, technology and methods have changed lifts from being merely metal cabins strung up on ropes to becoming sophisticated traffic control platforms that are directed by high-speed, smart computer networks. A far cry from the manually controlled, slow moving lifts of yesterday, today's elevators are controlled using highly complex calculations to determine the most economical and speedy way to move populations.

In effect, elevators have become vertical highways. And in order to make them practical rope manufactures must overcome challenges that stretch the very limits of engineering technique and materials capabilities as well.

Once separate players, today architects, system designers and hoist rope manufacturers find that they must closely work together so that future buildings can achieve greater heights. For only in this way will skyscrapers continue to climb and recall that audacious spirit to touch the sky that those Egyptian builders from long ago would still recognize.

The Challenge Of Today

The key to the rise of skyscrapers has been human innovation. No doubt one of the greatest innovations was the development by Elisha Graves Otis in the late 19th Century of a safety device that would engage should ropes fail. For without this the masses would never have accepted the logic behind tall buildings and future towers would never have risen more than a few hundred feet.

Unfortunately the push of innovation has created problems for designers as well. For while many have sought to dramatically increase elevator accelerations, decelerations and have pushed their frequency of usage *(or cycles)* to a point where many run almost continuously, other professionals *(being prodded by architects, tenants and building owners)* have sought ways to make elevator designs and machinery less massive and intrusive, so that valuable floor space may be freed up and used far more profitably.

Such mutually exclusive aims *(the desire for fast, high performance systems, versus the demand for system designs that are more compact— a process sometimes called "demassification")* have led to unanticipated strains and stresses that have impacted every type of elevator design in the field today.

Indeed due to the lift industry aggressively pushing system performance expectations, while simultaneously striving to make systems less massive, one would be hard-pressed today to still find an elevator design that was once highly prevalent throughout the industry— the traditional low-rise, slow moving, low-efficiency, 1:1 design lift, featuring a massive main drive sheave.

One of the greatest dilemma's for modern lift designers is "demassification". Or, in effect, shrinking the size of system components so that a lift occupies less valuable floorspace—while simultaneously meeting the same, or greater, design demands as before. Each advance in this field naturally creates new sets of challenges for rope manufacturers that must be overcome.

It Is A Brand New World That We All have to Face

One could even argue that due to the pace of technology, efficiency, cost, and popular demand, the very metrics that once clearly defined hoist rope selection into neat categories for Low, Mid and High-Rise installations have largely been rendered obsolete. Which means that practically every installation design in the world today is confronting engineering stresses and having to perform at levels that they were never initially designed to handle. By and large the majority of industry professionals today do not realize this.

We still hear in the field of old tales about hoist ropes that once lasted 40 years in systems providing nearly 200,000 trips/year and find that some are dismayed over the fact that basically the same rope today must be replaced after only a year and a half of service. Unfortunately what they fail to realize is that this system from the 1930s, with a D:d ratio of 64:1, a Double-Wrap roping arrangement and featuring round grooves has evolved into something else entirely.

More likely the system has been modernized and features a D:d ratio of 40:1, a Single-Wrap arrangement with one deflector sheave, a 95° Undercut U-Groove, higher usage *(due to fewer elevators being in the building now)*, and receives less than ideal lubrication and maintenance oversight because of budgetary cutbacks. Clearly we're talking apples to oranges and comparing the two equally requires a true stretch of imagination. It is easy to see then that it is the growing incompatibility between performance demands and design realities has led to the industry-wide increase in reports of system breakdowns, damaged sheaves and severely shortened hoist rope life expectancy.

And while some have taken the time to review the facts logically and find solutions, unfortunately a vocal minority has also arisen. One that seeks obvious villains to blame for their problems. However any calm examination of the evidence will show that this overall rise in system breakdowns is not due to system design flaws, or even mechanical or material weaknesses in components. That view is far too simplistic.

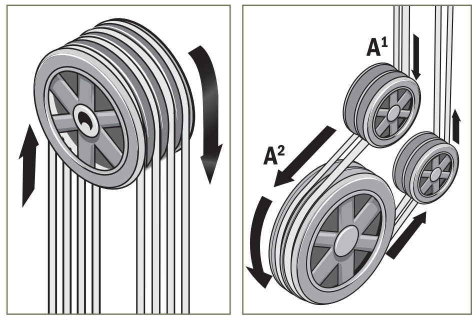
No installation plan, roping arrangement or sheave groove design, is intrinsically wrong or destructive to a hoist rope provided proper attention is paid to design parameters and rope specifications. And no hoist rope leaving the factory today is primed for failure or built to deliver less performance than its forebears either. Indeed modern ropes, shackles, and other components are made using advanced processes and quality controls that are far more rigid and exacting than they have ever been historically.

Instead evidence shows that the root cause behind the reported rise in installation breakdowns, the increase in recorded downtime, and the marked decrease in hoist rope life expectancy can only be attributed to the very nature of the choices that professionals must make. Each day they must balance a variety of incompatible factors, such as performance requirements, installation design, hoist rope selection, budgetary cost, short and long-term maintenance, and reroping expenses in order to obtain a mix of the greatest measure of performance for the least amount of cost. Which means that the major cause behind rope failure has far less to do with the actual physical sciences than it does with fiscal reality and the driving desire to maintain profitability.

Solutions Require A Change Of Tactics And HP Ropes

In order to answer today's elevator problems one has to lay aside ideas of what used to work in the "olden days", throw out ideas that seem to make "common sense", and discard old truths and prejudices. One must soberly look at the way the world truly is and try to understand and accept the direction the industry is now moving. The professional who can do this will find that, while no simple component change in a system can make all the difference in eliminating every problem, utilizing a High Performance hoist rope *(we classify such ropes as **HP**)* instead of one with Natural Fiber Core *(Sisal)* will see a noticeable improvement in performance and a marked reduction in elevator breakdowns.

Indeed the difference in rope life can be as much as 50% to 600% longer by converting from old fashioned Sisal core to HP Ropes. Such a

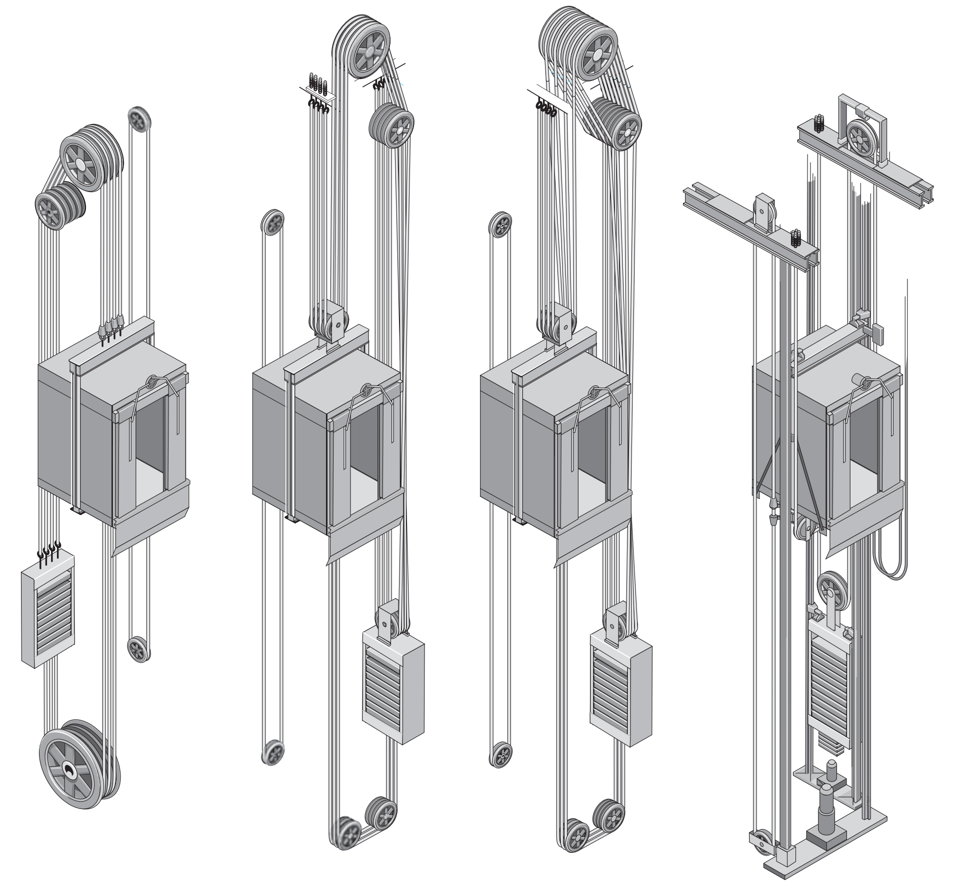


A Simple Bend (left) is where a rope travels over one sheave. In a Reverse Bend (right) a rope bends over a sheave in one direction (A^1) and then in the opposite direction (A^2). Such arrangements can seriously impact rope life, especially in installations where sheaves are spaced closely together.

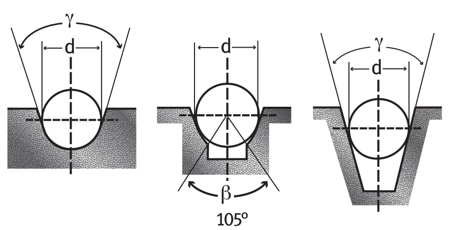
massive increase in rope life expectancy can greatly lower maintenance costs long-term, dramatically reduce reroping costs, and their enhanced capabilities can go far to preventing expensive sheave damage as well.

True, there are many factors one needs to review prior to selecting the right rope. Not all high performance rope designs are the same. And if chosen without adequate forethought, used inappropriately, or installed or maintained in a less than careful manner, even a high performance rope's full benefits will not be fully realized. Fortunately however, HP Ropes are more versatile and able to meet a far wider range of design needs, environmental conditions and budgetary demands than old-fashioned sisal core rope alternatives. HP Ropes allow the user to meet—and potentially exceed— modern system demands, instead of having to just make do with less with sisal alternatives.

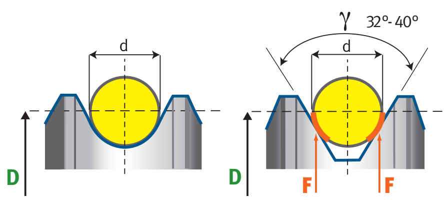
Additionally HP ropes can also be thought of as "High Potential" Ropes for future installation



Roping designs have evolved from simple 1:1 and 2:1 Double Wrap Systems with round sheave grooves to Single Wrap arrangements featuring Undercut-U and V-Grooves. Compact designs (MRL) have grown in popularity as well. (From left: 1:1 Single wrap, 2:1 Single wrap, 2:1 Double Wrap, MRL design)



Sheave grooves have changed from U-Groove designs to forms that feature undercuts to increase traction. (Shown from left: Round, Undercut U and V-Groove).



Changing from a Round (left) to V-Groove (right) creates natural rope pinch points. This leads to crown wear, strand deformations and hoist rope failure. Another consequence of such rope wear can be groove wear or imprinting.

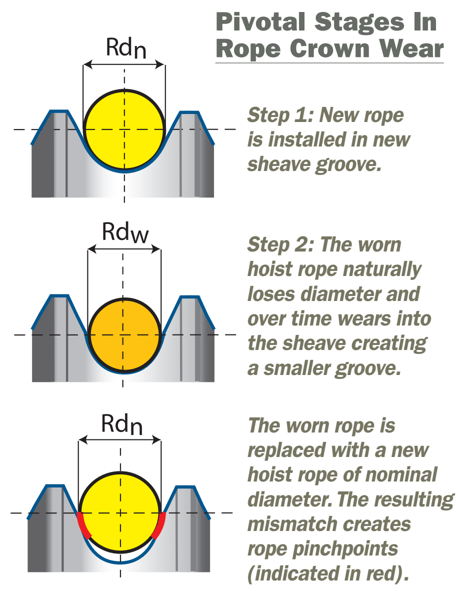
designers. For in the hands of a truly creative engineer the benefits of HP Ropes can potentially allow one to achieve high traction in high speed elevators, and still use smaller components *(aiding in demassification)*, without the need for highly complex roping arrangements requiring multiple, closely placed deflector sheaves, which create potentially problematic fleet angles for ropes.

However one fact is apparent— what was once acceptable as the status quo is no longer. Elevator systems are breaking down more frequently due to the increasing demands of modern elevators. And even the dullest fans of Sisal Core ropes *(those who constantly expound upon Sisal's lower initial cost)* have to concede the fact that this design of hoist rope presents serious problems for professionals. In fact this variety of hoist rope is now on a one-way evolutionary road to class extinction.

Today's Current Realities

Today thanks to the demand for MRL *(Machine Roomless)* installations and the need for systems that occupy far less floor space, old-fashioned overhead and basement roping arrangements utilizing large drive sheaves have largely disappeared. Instead one finds that Single Wrap and MRL designs have become by far the more popular choices.

In addition, one today finds that hoist ropes are put through more bends *(which is prevalent in Underslung designs)* and reverse bends than ever before. When coupled with the use of close, multiple deflector sheave placements and wide fleet angles *(which, unfortunately, are the inevitable result of trying to compact the elements of a system more closely together)*, hoist ropes experience a dramatically shorter life expectancy.

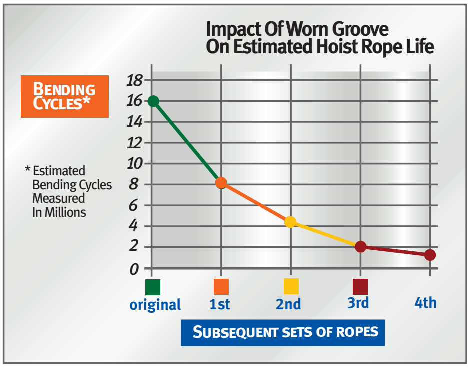


A new rope running in a worn sheave groove will experience crown wear and early rope death. This pattern of reduced rope life and decreased performance will become even more pronounced if the sheave is not remachined or replaced.

Shorter rope life is also the consequence of higher specific pressures within the sheave groove itself. And this is largely due to the necessary move from the use of Round Grooves on large sheaves, to the use of U and V-Grooves that feature aggressive undercuts in order to increase traction.

Unfortunately many fail to realize that hoist rope and sheave, while singular components, create a dynamic environment where each profoundly affects the other. Wear and friction between rope and sheave eventually leads to a gradual reduction in rope diameter. And this reduction allows the rope to settle more deeply inside the sheave groove, eventually creating a new, narrower groove within the original one.

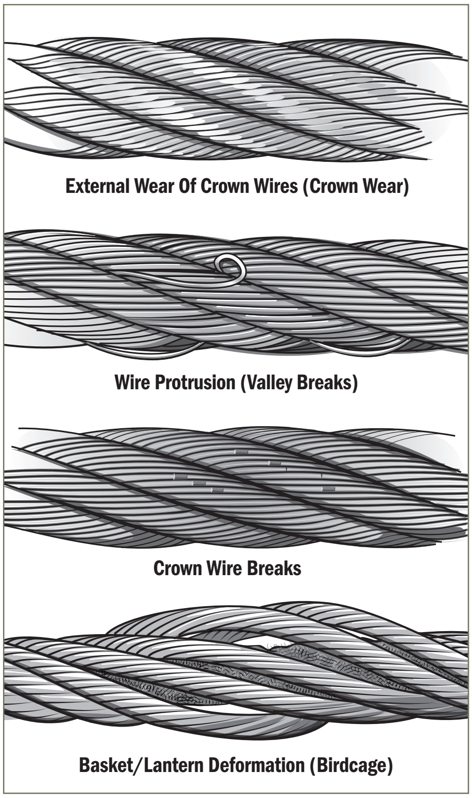
Thus when the old rope is replaced with a newer rope that matches the original diameter tolerances, the worn groove's altered cross-section will create pinch points. Such pinch points are the reason why, even if one tries to



Rope life expectancy is adversely impacted in an inversely exponential manner when successive generations of ropes are placed on worn sheaves that feature unequal groove depths.

match the original rope by purchasing the same rope from the same manufacturer, rope life will be far shorter when compared to the first roping. This unfortunately is reality.

In addition to higher specific pressures within the groove, the Undercut U and V-Grooves cause the rope to devolve from its pristine round profile

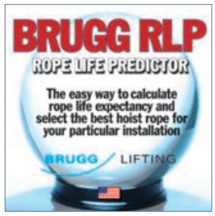


Large fleet angles, high groove pressures, demanding groove profiles, and sheave grooves that contain depth discrepancies, can result in evidence of rope failure—a few common ones we have detailed above. Couple this with less than careful rope handling and infrequent system maintenance and you can understand why professionals report tales of less than anticipated rope life. For more details on rope deformation review our literature online.

to one that is more ovoid, or egg-shaped. This can lead to concentrated pinch point areas within the groove creating rope crown wear *(external wear)*, crown wire breaks, wire protrusions and basket/lantern deformation, and the near certain possibility of costly sheave wear and groove depth variations.

A crucial component behind rope failure is the gradual reduction in D:d *(D:d is the crucial relationship between "D"—sheave diameter—and "d" which represents rope diameter)*. Today it is not uncommon for many elevator systems to actually push the 40:1 limit that is allowed by code. And many new systems even push safety factors to the actual minimum allowed by reducing the overall number of hoist ropes used. Though this situation is legal, it forces hoist ropes to carry even greater loads.

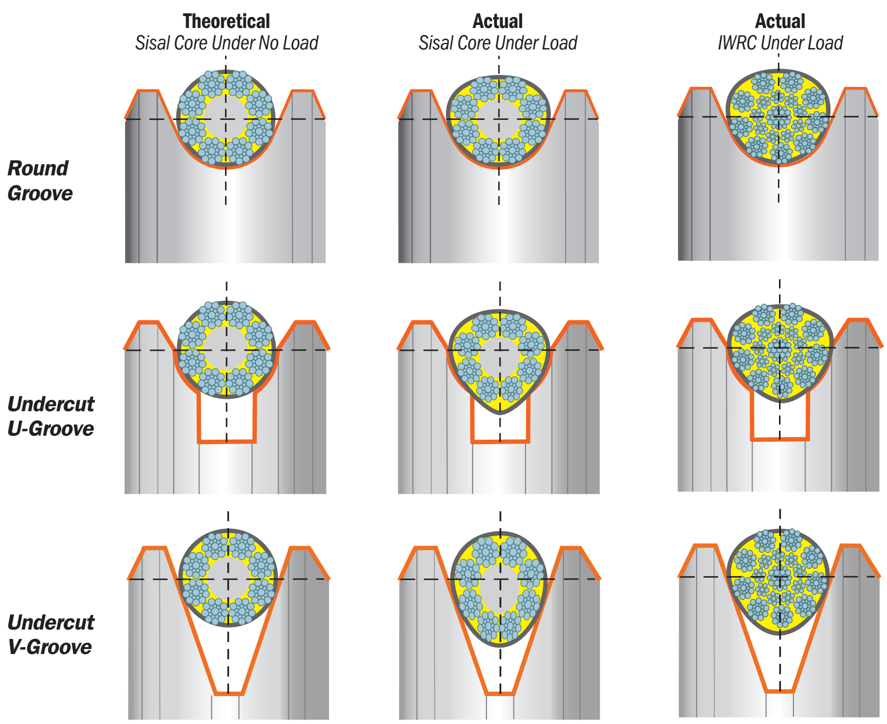
Klaus Feyrer *(of the Institute of Mechanical Handling and Logistics at the University of Stuttgart)*, this online innovation allows the user to avoid the heavy math previously necessary. Now the user is able to calculate the rope life



Brugg RLP is the industry's only online application that allows you to enter specific system data to calculate rope life expectancy in real time.

of many different constructions while still being able to change a wide range of multiplicative factors *(for details go to www.bruggrope.com, register and try Brugg RLP free for 30 days)* to see how those factors impact rope life.

The Impact Of Groove Profiles On Hoist Rope Deformation



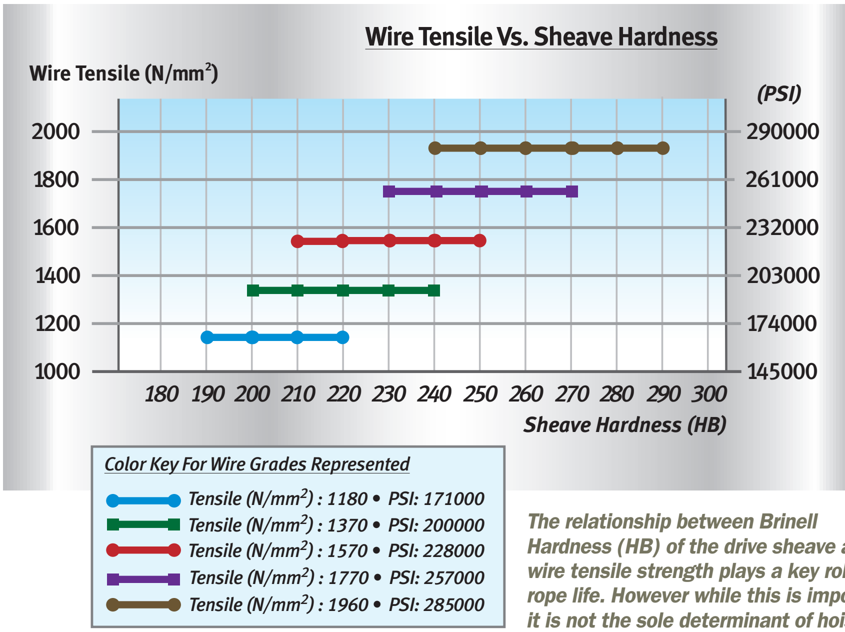
Note the negative impact that sheave groove profile has upon hoist rope symmetry. This is particularly evident with old-fashioned sisal rope core designs. A Steel Core (or advanced Mixed Core) rope construction shows far less deformation, less wear and exhibits far longer rope life.

The Keys To Selecting The Right Hoist Rope

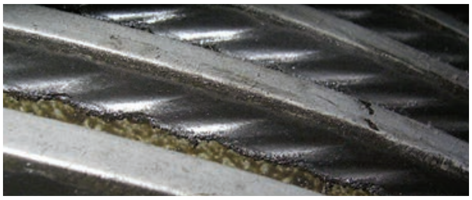
In 2009 Brugg Lifting created RLP *(Rope Life Prediction)*, an online app that allows the user to enter key data and calculate with 95% confidence the number of bending cycles where a maximum of 10% of hoist ropes reach discard criteria. Based on the calculations of Prof. Dr.

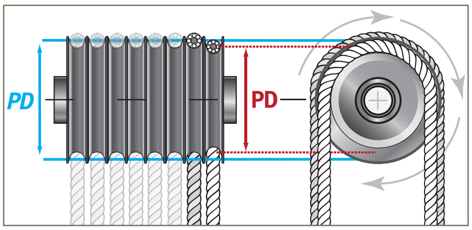
While primarily designed as both a rope selection and a system modeling tool, RLP serves another important *(though underappreciated)* function as well—educational.

With RLP one can graphically see how the drive to maximize profit can severely impact rope life and lead to more reropings *(which is a long-term maintenance cost)*. Equally one can evaluate how increased rope load, multiple rope bends, smaller D:d ratios, different groove



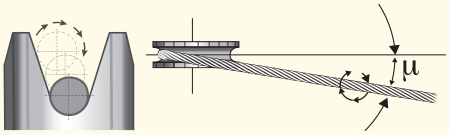
The relationship between Brinell Hardness (HB) of the drive sheave and wire tensile strength plays a key role in rope life. However while this is important, it is not the sole determinant of hoist rope and sheave compatibility.





A mismatch in hardness between hoist rope and sheave can create sheave groove depth variations, or enhanced sheave groove wear (seen above) which leads to rope degradation and loss of performance. The blue line indicates correct pitch diameter, while the red reveals groove depth variation, which equates into a difference in pitch diameter. Simply replacing the hoist ropes may temporarily improve system performance but rope life expectancy will not see any extension.

Fleet Angles Have A Dramatic Impact Upon Rope Life



One must monitor fleet angles closely to minimize the degree of misalignment. Too wide an angle induces torsion into the ropes causing them to roll into sheave grooves. This can lead to premature rope wear being evident along one plane of the rope. A simple 4° fleet angle can reduce hoist rope life by as much as 33%.

profiles and higher rope speeds degrade hoist rope life.

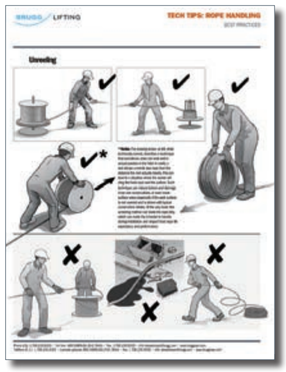
However until you have a chance to use RLP we have taken some of Dr. Feyrer's key factors and have divided them into a few basic areas, or aspects, that one should evaluate prior to selecting a hoist rope to handle today's advanced systems. As you will see, there's far more to choosing the right rope than simply trying to replicate a former choice by using an old rope tag, or trusting your gut. If you're forming a decision based on feelings or solely using price as your guide then you're asking for trouble.

System Demands— To Determine The Hoist Rope You Must Know The System

In short, what are the key characteristics of the system that you are selecting the rope for? If you had little *(or no)* documentation from a previous roping to guide you *(unfortunately less than rigorous documentation procedures seem to have become the rule rather than the exception today)* would you know what you should be looking for? For instance, have you considered:

- ***D:d ratios***
- ***the number of bends and (if any) reverse bends in the system***
- ***arc of Contact (degree, specific pressure)***
- ***load (safety) factors — both actual and expected***
- ***sheave groove profile (to achieve traction)***
- ***speed (acceleration and deceleration)***
- ***the amount of system usage (the number of cycles expected)***

And after you have defined these and other additional factors you must remember that each factor impacts others in a multiplicative *(not merely additive)* manner. Unfortunately even if you could ascertain all the factors mentioned, you still would not have enough data to have a solid set of facts to use in selecting a hoist rope.



Good installation and maintenance technique are vital to rope longevity and good system performance. We provide both equipment, such as (clockwise), VT Lubricator, VT Lube, Brugg GDC and Brugg RLE, and detailed data (shown at bottom) to aid you in your efforts.

Installation— How Well It Goes Up Says Plenty About How Long It Will Stay Up

Unfortunately many base their hoist rope selection upon only the barest of engineering details. They fail to understand that rope is far from being a simple mass of stranded steel wires, it is a mechanism that offers a surprising number of moving parts and has been precisely constructed. To pick a rope without considering how it will actually be installed or used gives one at best an incomplete picture. Instead we suggest one should consider:

- ***the amount and sort of handling the rope will encounter before and during installation***
- ***if the hoist rope will be subject to unplanned twist and torque***
- ***will the hoist rope have to deal with unplanned angles***
- ***does the rope installer have the needed skill to avoid overloading during installation***
- ***the effects of constructional and elastic stretch***
- ***will the installation process permit load equalization afterwards***

Naturally these factors are hard to empirically evaluate, however they are critical. For no matter how well the rope made, less than careful installation can severely hamper performance and rope life. Not considering how the ropes will be treated during the early stage of their overall developmental life is shortsighted and foolish — and potentially costly.

Maintenance —The Last Aspect To Be Considered Should Perhaps Be The First Detail You Think About

All too often maintenance is given little emphasis by rope manufacturers. And some in the field have taken this blasé attitude as an indication that this is of little importance when it comes to choosing the right rope. This is a fallacy. Before selecting a hoist rope you should consider:

- ***how frequently (and thoroughly) the rope will be inspected***
- ***whether the rope will receive adequate lubrication***
- ***will the rope be used in an area that is environmentally controlled (freedom from moisture, dirt, or debris in the hoistway)***
- ***will the maintenance crew periodically detail actual usage rates and evaluate the rope for obvious signs of wear***
- ***whether the maintenance contract allows for periodic checks to check rope tensions and provide the means to equalize loads***

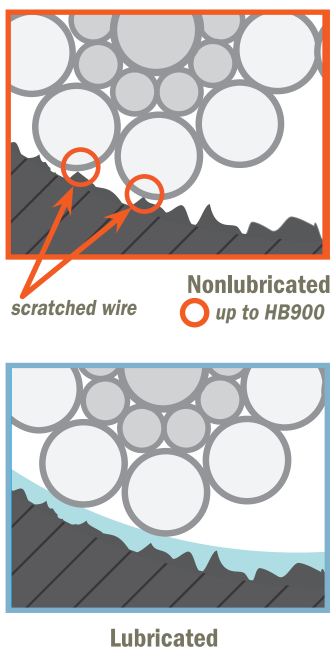
Certainly if you are a designer *(or are a maintenance professional who has a short-term contract)* you may have no way to answer the questions posed above. However one needs to remember that proper maintenance *(which includes periodic lubrication and rope load equalization)* can avoid costly damage to sheaves, greatly curtail the occurrence of installation breakdowns overall, limit system vibrations and noise, and greatly improve performance. If you're looking to turn a short-term maintenance contract into a long-term service client the best way to do so is to insist that the proper rope be used in the first place. And the only way to ascertain that is by carefully considering the factors we have listed prior to making your final rope selection.

Parallel Design Or Point Contact Rope Construction

Simply put, a Parallel Lay rope construction is where the inner and the outer strands are laid simultaneously in one operation. In a parallel rope the lay length of inner and outer strands of any two superimposed layers are equal. This results in line contact of the strands.

This kind of construction results in ropes where the strand of an outer layer is supported by two strands of an inner layer. Parallel laid ropes with two layers of strands may have Filler, Seale or Warrington *(or a combination of these)* constructions. Parallel designs create ropes that offer both a high breaking strength and favorable fatigue bending characteristics.

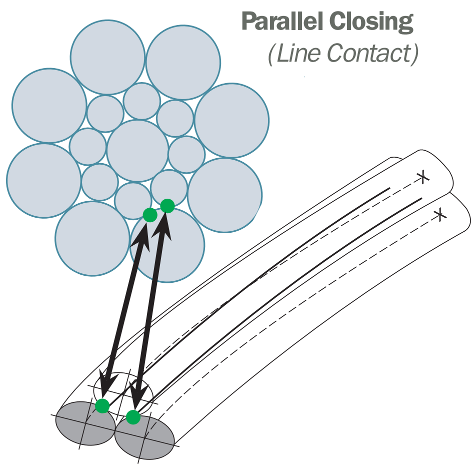
Sheave Groove Roughness

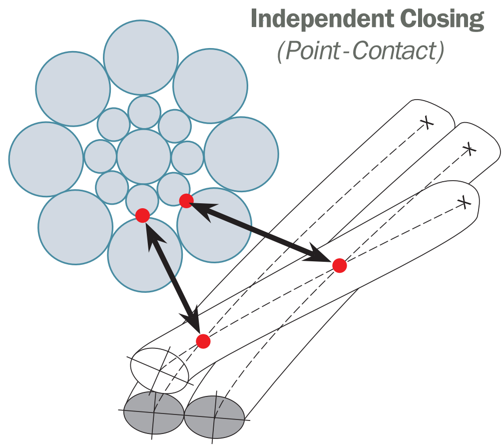


Over time a sheave groove will be polished due to its interaction with a rope. Rope lubrication can help prevent the scratching of outer wires that can occur.

However parallel ropes can be susceptible to untwisting, either during installation or when used in situations where close multiple rope deflections *(reverse rope bends)* at harsh angles are required.

When handling parallel ropes always follow recommended manufacturer guidelines and exhibit care, as aggressive handling will damage hoist ropes and consequently shorten rope life.





A Point Contact design rope *(IWRC)* is one whose inner and outer strands were laid independently in separate work processes. Though not exhibiting as high a breaking force as Parallel designs, Point Contact *(IWRC)* ropes are better able to tolerate the more casual rope handling techniques one usually finds at most installation sites. In addition, Point Contact ropes offer advantages in modern installations that feature multiple bends, smaller sheaves, and close sheave placements.

Forget Generic Advice — Find Out The Real Answers For Yourself

As we have indicated making overall, generalized statements concerning which rope best suits the needs of various installations is hard to make. The various factors that must be evaluated, budgetary considerations, and the overall expectations of performance impact any selection. A far more efficient way to determine the appropriate hoist rope for your needs is to simply use Brugg RLP and enter the specific key data for yourself. Within minutes you can create visual scenarios that allow you contrast rope choices and determine which rope is correct.

A Few Words Concerning The Subjects Of Elastic And Constructional Stretch

Though few would make a hoist rope selection based upon such peripheral issues concerning Elastic or Constructional Stretch it does enter into any cost discussion due to the fact that ropes *(whether they call themselves "prestretched" or whether the manufacturer takes this factor into consideration in the rope's construction)* do occasionally require shortening, and this can take a professional crew several hours *(and maybe more than once)* to perform. Unfortunately some in the industry find the terms confusing and mistakenly interchange them.

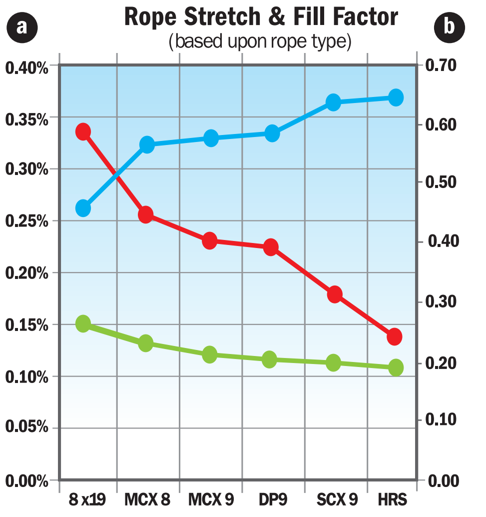
Truthfully any hoist rope will stretch to a degree under load due to the helical nature of its components. And when that load is removed the rope will return to its original length, hence the term "elastic stretch".

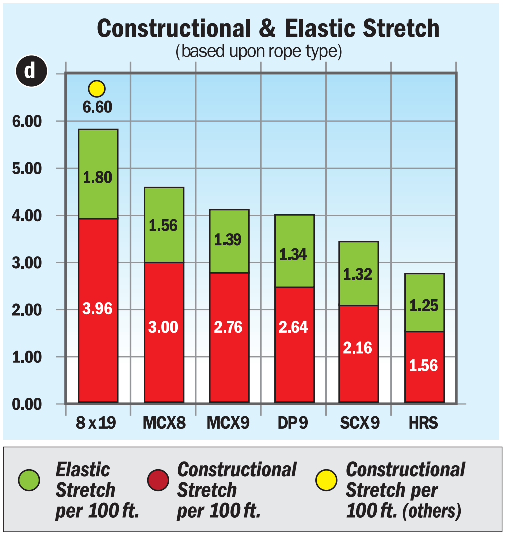
Admittedly it can be difficult to distinguish between the effects of constructional stretch and elastic stretch when one is installing a new rope. To determine Elastic Stretch one must consider rope construction, the number of strands, core design, lay direction and rope load.

Constructional Stretch differs somewhat from Elastic Stretch in that it is a permanent feature. When any load is applied to a helically set assembly of wires and strands the rope will constrict. This contraction squeezes the rope core and causes a slight reduction in overall rope diameter as all the elements within the rope's construction draw closer together. Simultaneously as core diameter shrinks hoist rope length increases as well.

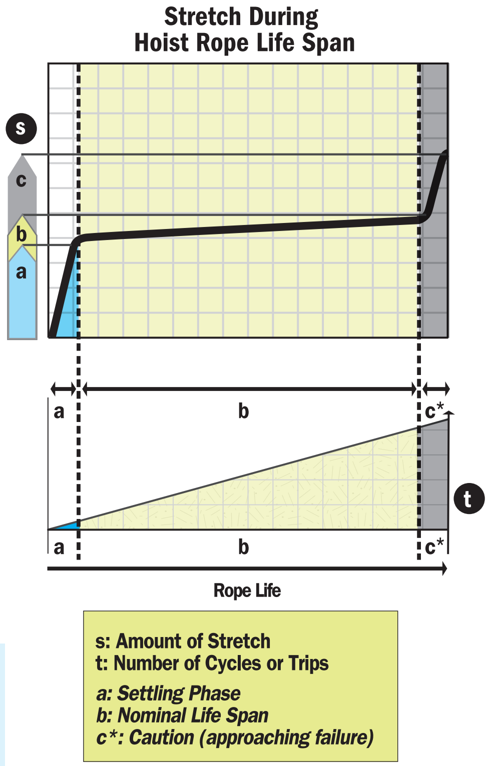
It is difficult to define a finite value for the amount of constructional stretch due to the fact that one must consider a wide range of factors including: core type, rope design, lay direction, rope length and load. In addition one must also consider the multiplicative effects of car weight, rope speed, roping configurations, acceleration and deceleration, shaft height and sheave conditions.

During a typical lifetime hoist rope can be said to go through three distinct phases of constructional stretch *(refer to chart detailed above right — **Stretch During Hoist Rope Life Span**)*:





d: inches/100 ft. of rope length



The charts "Rope Stretch & Fill Factor" and "Constructional & Elastic Stretch reveal one of the less desirable qualities of Standard Sisal Core rope versus HP (High Performance) selections. Obviously, greater amounts of metal present in a rope's cross section will reduce the negative effects of constructional and elastic stretch. However hoist ropes of all core designs will stretch over their lifetime. This quality is especially evident early in its service and then later as it approaches replacement. All professionals should remember that stretch is a completely natural characteristic in ropes and cannot be eliminated—however its impact can be reduced through careful selection.

Settling Phase (a): After installation as the new rope adjusts to the system. During this period all elements seat properly within the rope *(this is often referred to as the "run-in"period)*.

Nominal Life Span (b): The lengthy service segment of the rope's life. The rope shows only slight overall increase in stretch due to wear and the effects of fatigue.

Tertiary (c): Constructional stretch rapidly increases due to prolonged rope usage. The rope rapidly begins to degrade *(which is evident due to an increase in wire breaks, reduction of core support, rope diameter reduction and possible rouging)*. At this point the rope should be replaced to eliminate the potential for catastrophic rope failure.

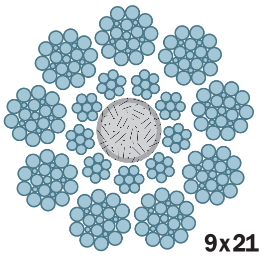
Though the topic of stretch is a complex subject certain general rules may be followed when selecting a hoist rope. First, in order to greatly diminish the effects of Elastic and Constructional Stretch, select a rope that offers a high fill factor. One should also choose a rope with more strands as this gives it a greater capacity to remain round under load. Which in the industry today commonly means choosing 9-Strand ropes.

Naturally some may find such guidelines untenable due to concerns over rope weight *(or expense)*. In that case one should consider using Brugg's High Performance rope *(Parallel or Point Contact)* selections. Here we offer a wide range of core designs, wire strengths, and rope constructions that can maximize performance at an affordable cost.

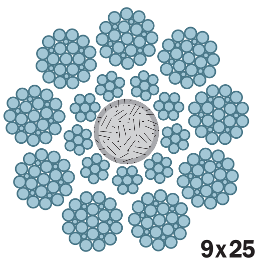
Parallel Hoist Rope Design Selections

PWRC/Brugg DP9

Designed to offer very round cross-sections for Mid-rise and High-Rise installations. This Double Parallel design offers very good bending fatigue characteristics, high flexibility, high breaking strength, high ride comfort and low elongation properties. The polyethylene core *(the combination of Polycore and steel wire inner strands that surround it create a configuration that many refer to as "Mixed Core")* provides great strength yet serves to reduce overall hoist rope weight.



9x21 F—PWRC



9x25 F—PWRC

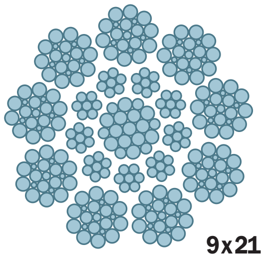
9 x19 PWRC ropes are designed to better handle the high demands of modern high-speed elevators yet still be cost-efficient. Made to offer occupants a smooth ride, such ropes can be used in long rope lengths and in installations that offer multiple sheave deviations.

As with any Parallel construction, care must be exhibited during rope installation as such designs are more sensitive to twisting (opening up) during handling. Less than careful handling can result in greatly reduced host rope performance and in shortened rope life expectancy overall.

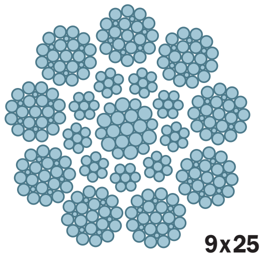
PWRC/Brugg HRS

This 9-Strand Double Parallel rope design presents a very round cross-section under load, especially when compared to typical 8 x19 NFC ropes. HRS provides excellent flexibility and high strength for both Mid-Rise and Hi-Rise installations.

9-Strand designs are characterized by their high breaking strength and very low permanent



9x21 F—PWRC



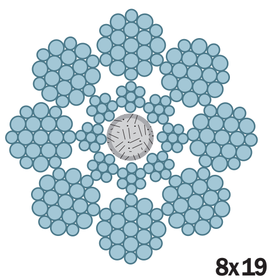
9x25 F—PWRC

and elastic elongation. As with DP9, such a hoist rope is highly suitable for usage in high performance traction sheave elevators with high comfort requirements, high rope speeds, multiple sheave bends and close deflector sheave placements. Such a hoist rope can be used in long and extremely long rope lengths. Brugg HRS is a good choice for demanding, aggressive undercuts and particularly in Mid-Rise installations where weight restrictions are of little importance.

9-Strand ropes are more forgiving towards certain soft sheave constructions. All Parallel ropes must be handled carefully as they are more sensitive to aggressive handling during installation. Special attention must be paid in order to prevent the rope from twisting *(open or closed)* during installation.

Point Contact Hoist Rope Design Selections

IWRC/Brugg MCX8



8x19 W—IWRC

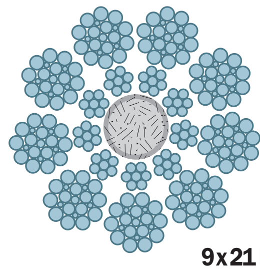
This 8-Strand rope is of Point Contact *(IWRC)* design. Like all Point Contact designs in our X-Series this rope can handle wide sheave undercuts and is an exceptional choice in medium to heavy-use Mid and High-Rise installations. Its Mixed Core *(steel wire strands wrapped around a polyethylene core)* design creates a hoist rope that is lighter than a steel core rope *(such as Brugg HRS)*. And its construction offers users high breaking strength as well as low permanent and elastic elongation rates.

MCX8 performs well in highly demanding environments.

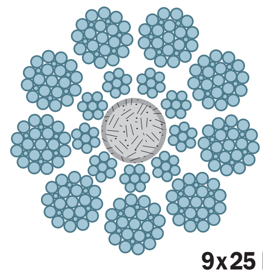
The installer must always remember to take precautions during the installation of IWRC ropes to avoid untwisting.

IWRC/Brugg MCX9

As with MCX8 this 9-Strand Mixed Core Point Contact construction offers even greater advantages. MCX9 is made to be able to bear the bending cycles created by close sheave placements. Such a rope design offers users high breaking force, a very round cross-section, great flexibility and very low permanent and elastic elongation qualities.



9x21 F—IWRC



9x25 F—IWRC

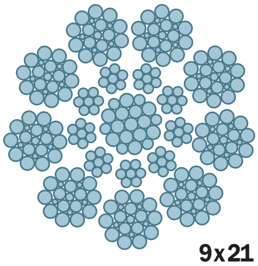
However MCX9 need not be confined to use in only Hi-Rise installations alone. Due to the prevalence and rising popularity of aggressive "tight" roping designs now being used in various Mid-Rise *(and some Low-Rise as well)* elevator installations, MCX9 is well able to handle the increase in the fatigue cycles, offer a smooth ride, and still be able to provide increased rope life expectancy as well.

We highly recommend prior to any reroping that all sheave grooves be carefully inspected *(and groove deviations be rectified)*. While some believe that it is possible to get far more usage from a worn sheave by using HP ropes, a better course of action would be either to re-machine the sheave or replace the sheave entirely before wear becomes so obvious that no hoist rope can provide optimum performance regardless of how well the rope is lubricated and rope tensions are equalized.

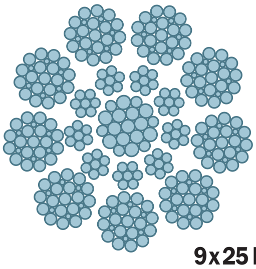
Unfortunately there is as yet no preinstalled warning system built into a hoist rope to tell you precisely when it will expire (though that would be handy). And while Brugg RLP provides a degree of confidence in calculating rope life that is unmatched in the industry, it will never replace the experienced eye of someone in the field.

However the naturally imperfect fibers that are used in old-fashioned Natural Fiber Core hoist ropes (seen in inset) cannot handle the strains and requirements of today's systems. This is not opinion—it is fact. If there were such a device as we show here perhaps it would help others make better rope selections. But until that day we'll keep preaching about High Performance ropes and hope that professionals will listen.

IWRC/Brugg SCX9



9x21 F—IWRC



9x25 F—IWRC

Brugg SCX9 Steel Core Point Contact design is one of the top choices for High-Rise elevator designs *(or extremely demanding Mid-Rise)* and traction drive elevators utilizing multiple deflection sheaves, or in installations with secondary or deflector sheaves.

This 9-Strand IWRC Steel Core hoist rope offers very low diameter reductions over its lifetime, a high breaking force, a very round rope cross-section, high flexibility, and a very low constructional and elastic elongation rate.

SCX9 was designed to handle the stresses and pressures of modern, aggressive “tight” roping design elevators and is better able to withstand the rigors of routine installation handling and demanding shaft environments.

We highly recommend you closely examine sheave grooves for deviations prior to selecting SCX9, as adequate usage may require you either re-machine the entire sheave or replace the sheave entirely.

The Dodo (Raphus cucullatus) is an apt metaphor to us for Sisal Core ropes. This bird species thrived on the island of Mauritius as long as its environment remained static and undemanding. However environmental changes led to its extinction only 83 years after its discovery. Likewise Sisal Core hoist ropes have been in use worldwide since the popularization of elevators in the late 19th Century. Considering the rise of higher elevators (some even propose lift designs to reach craft in Earth orbit) one has to wonder— how much time is left for the Sisal Core hoist rope species?

HP Ropes Offer A Simple Solution To An Continuing Dilemma

Unfortunately, as much as we would like to permanently put to rest the idea of sisal core hoist ropes once and for all, we must realize that there are still some who are determined to use it due to either headstrong prejudice or simply because they only consider its low initial sticker price. They simply fail to acknowledge the costs *(both long and short-term)* that will follow, such as equipment failure, installation downtime, increased sheave wear, and the inevitable, frequent multiple reropings to follow that will only deliver shorter and shorter rope life expectancy.

Certainly we regret their choice but, frankly, there is nothing we can do about it. We only hope that the results of such stubbornness will not be too heavy a lesson for them to bear.

Our hope is that enlightened professionals will ask a Brugg Lifting representative for more information so that they can find a better way to solve the current problems they are facing and prepare for future systems that will present even greater challenges. In time engineers may create new materials, processes, and installation designs that will overcome the problems we have discussed. It’s even possible that future systems will soar higher yet deliver less wear and tear on components and ropes than they do now. However history does not point in that direction. To be able to handle the challenges we face now and ahead there is only one cost-effective hoist rope choice — ***Brugg HP (High Performance)***.

In an industry where saving time and money are paramount in business success, using Sisal Core hoist ropes can cost you both in system performance and increased downtime.

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