# HIGH PERFORMANCE ROPES UNDERGROUND MINING

Driving Progress around the World

Edition 06/2023

# INTRODUCTION

## WIRECO

**Quality Products, Outstanding Service and Comprehensive Technical Support – It's what today's industries expect from their supplier partners. And that's what WireCo WorldGroup is all about.**
WireCo WorldGroup is the global market, manufacturing and technical leader in wire and synthetic rope manufacturing, providing a consultative approach to offer customers a single, reliable source for performance matched solutions to fit their specific application and budget needs. But it doesn't stop there.

WireCo WorldGroup offers clients the education and expertise needed to enhance product performance and value. With our comprehensive range of trusted, global brands we deliver unmatched technical expertise and innovation as well as unparalleled quality assurance meeting and exceeding international quality certifications.
WireCo WorldGroup is on the ground everywhere you are – with manufacturing and distribution facilities all around the world and about 4.000 global employees supporting these efforts. Our customers enjoy global availability for a consistent, responsive supply no matter where and when they need it.

## CASAR

Deeper shafts. Higher payloads. Faster speeds. Underground mining becomes more demanding every day.
To efficiently hoist materials and personnel from underground, we have developed specialized underground ropes to meet this challenging but also permanently changing environment.
WireCo WorldGroup is a world leader in wire and synthetic rope manufacturing. From hoisting to hauling, you can rely on our ropes to reliably meet the demands of your operation. Drawing on more than 70 years of global mining experience, we've developed specialized products that overcome obstacles and improve service life. Combined with our unmatched field expertise and consultative approach, it's everything you need to maximize performance and value for your mining application.

The impressive strengths of the high-performance CASAR ropes are particularly evident when it comes to underground mining. For many decades, our engineers have been working closely with the mines as well as state and private institutes to improve the performance of the types of ropes used underground.

### So why select CASAR ropes?

CASAR stands for highest technical demand. All wire ropes are developed by the use of special computer technology and approved at one of the various test facilities. CASAR Special Wire Ropes are known all over the world because of their high breaking loads, their excellent rotation resistance and their particularly long service time.
In order to keep its leading position in the market, WireCo invests permanently in new technologies to improve its products and testing facilities. Quality is self-evident for CASAR ropes. For many years the company has been certified by the ISO EN 9001 and approved by many classification societies.

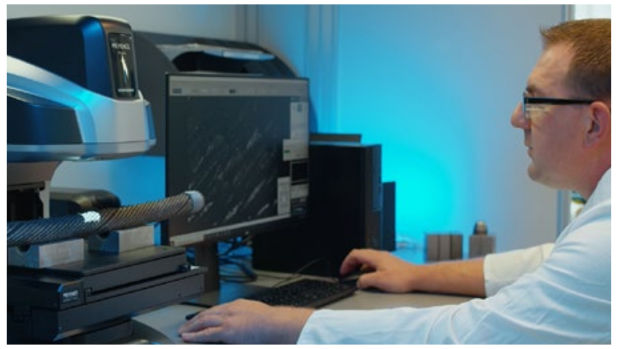
### The most comprehensive range of products.

Through our Casar brand, we are committed to providing the broadest range of special steel wire ropes for all of your mining applications. Our comprehensive line of underground mining ropes for drum hoists, friction winders, shaft sinking and many other applications offer strength and reliability while ensuring convenient sourcing for all your needs, including specialty applications.
Innovative CASAR hoisting products deliver precisely engineered and custom designed solutions for all challenging mining applications.

- Proprietary German-engineered designs deliver record setting service life
- Lower torque designs and innovative wire arrangements require less maintenance and resist drum crushing – lowering cost of ownership and improving mine profitability
- Decades of global mining experience and on-site engineering support help enhance safety and further improve rope performance
- Wide range of different product solutions to fit application requirements
- Global mining and manufacturing experience ensures reliable product performance

### Superior quality in all we do.

From raw materials to training and testing, at WireCo WorldGroup we take quality as seriously as you do. With an ISO 9001 registered quality system for all plants producing mining products, you can have assurance in every product you order. Also, we produce ropes in accordance with many different national and international quality and safety standards. All of our manufacturing sites utilize the same corporate quality system, ensuring that the same quality processes are followed regardless of manufacturing location. By committing to quality in every product, we are able to provide consistently high performance that delivers greater value. For a complete list of our quality certifications, visit www.casar.de or www.wireco.com.



### Service that adds value.

Our representatives are there for more than taking orders. They are available to help you with product selection as well as proper installation, use and maintenance. Backed by an experienced engineering team, they can facilitate custom designs and provide training and information to further enhance performance and value.

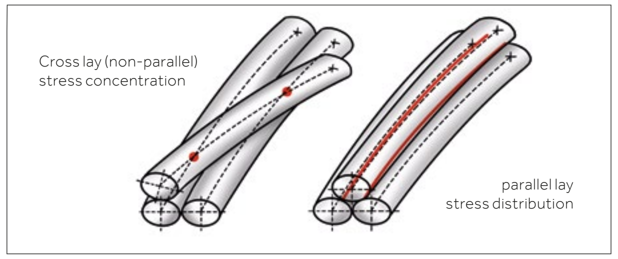
Expertise. Experience. Exceptional products. That's the WireCo advantage – helping customers find and apply the right solutions to minimize cost and maximize value.

# CONTENTS

# GENERAL DEFINITIONS

## PARALLEL LAY ROPES

In a standard rope all wires and strands have different lay lengths. The high stress concentration at the crossover point leads to an early internal failure. In a parallel lay rope all wires and strands have the same lay length. The linear contact leads to an optimal stress distribution. Furthermore the compacted parallel design leads to a higher fill factor and breaking strength.

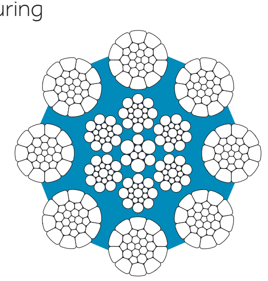



## ROPES WITH PLASTIC COVERED STEEL CORE (SINCE 1972)

In a CASAR PLAST rope, the proportion of plastic to the steel components is thoroughly harmonized in order to fulfill the aspired rope geometry. A plastic coating with a very constant thickness and quality is extruded around the steel core. A thermal aftertreatment just before the closing of the rope ensures that the outer strands are deeply implanted in the plastic jacket, thus forming plastic edges which separate the strands.

The benefit of an internal plastic layer is diversified:

- Prevents internal wire breaks
- Prevents metal-to-metal contact
- Stabilizes the rope structure during installation and operation
- Seals in lubricant, reduces the maintenance effort
- Keeps out water and abrasive elements
- Absorbs dynamic energy
- Resistant to many chemical substances



Rope with plastic covered steel core (red)

## SWAGED ROPES (SINCE 2003)

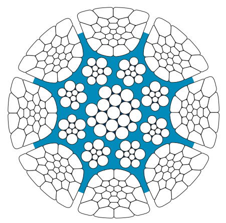
Swaged ropes are designed for heavy duty applications such as multiple layer spooling.

- Extremely high pressure resistance
- Reduced diameter reduction under tension
- Strongly improved crushing resistance in crossovers
- Extremely smooth surface for less indentations or pressure
- High breaking load

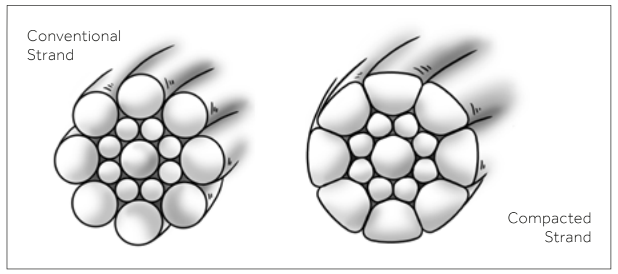
## ROPES WITH COMPACTED STRANDS (SINCE 1978)

Ropes made of compacted strands have a higher breaking load, a greater flexibility and better rope-to-rope contact conditions than comparable ropes made out of conventional strands. Because of the thicker outer wires and the smaller exposed area they are more resistant to abrasion and corrosion. The formation of negative impressions is significantly impaired. The rope life time on multiple layer drums is optimized.

In order to produce a compacted strand, a conventional strand made of round wires is drawn through a compacting tool. During this procedure, the wires are plastically deformed, the strand diameter is reduced and the surface is made smooth. The result being that the contact conditions between the individual wires and the strand-to-strand contacts are improved.



Swaged rope for heavy duty applications




## LUBRICATED

As a standard feature, CASAR special wire ropes receive intensive lubrication during the production process. This in-process treatment will provide the rope with ample protection against corrosion and is meant to reduce the friction between the elements which make up the rope as well as the friction between rope and sheaves or drums. This lubrication, however, only lasts for a limited time and should be reapplied periodically.

## PRODUCTION TOLERANCE

CASAR special wire ropes are produced within a tolerance range between +0% and +4%. Generally the standard production tolerance is at the upper limit of the tolerance range, between +2% and +4%. For this reason CASAR special wire ropes fulfill the requirements of famous drum manufacturers. Of course, special tolerances or limited tolerance ranges can also be covered.

## SWIVEL USE

Rotation resistant ropes can be used with a swivel. All other rope constructions may not be used with a swivel!

ISO 21669 – General guidance on swivel use (rotation resistance)

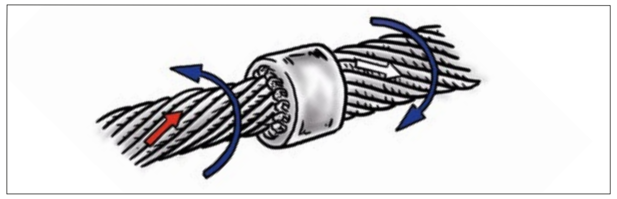
- Less than or equal to 1 turn/1000d lifting a load equivalent to 20%MBF, a swivel can be used
- Greater than 1 turn but no greater than 4 turns/1000d – a swivel may be used subject to the recommendations of the rope manufacturer and/or approval of a competent person
- Greater than 4 turns/1000d – a swivel should not be used

## PREFORMED ROPES

In particular the non-rotating ropes are preformed for better dimensional stability during production.

### Rotation-resistant ropes since 1949

In a conventional rope, an external load creates a torsional moment which tries to un-twist the rope. A rotation resistant steel wire rope has a steel core which is an independent rope, closed in the opposite direction to the outer strands. Under load, the core tries to twist the rope in one direction, the outer strands try to twist it in the opposite direction. The geometrical design of a rotation resistant wire rope is such that the torsional moments in the core and the outer strands compensate each other over a wide load spectrum, so that even with great lifting heights practically no rope twist occurs.



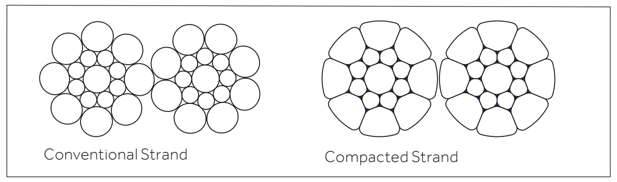
## MULTIPLE LAYER SPOOLING

A drum coiling a rope in more than one layer is a multiple layer system with new demands to a wire rope.

- Low diameter reduction under tension
- Crushing resistance in crossovers and layer crossovers
- Extremely smooth surface for less indentations or pressure in crossovers

The following rope properties are required for a long service life:

- Lang's lay to prevent indentations
- Compacted outer strands to prevent indentations

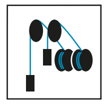


# DRUM WINDER

Mine hoist that winds a rope on and off a winder drum. There are single drum arrangements, today mainly operated for emergency or auxiliary hoisting, winding a single rope to hoist a guided or unguided conveyance. Beside the single drum winders, there are double drum winder machines hoisting two conveyances each with one or two hoist ropes. The latter is referred to as a BMR or BLAIR winder (named after its inventor Robert Blair).

In most applications, the hoist rope is mulit-layered on the drum. At a single rope layer drum, the rope travels around smooth, curved surfaces of the same geometry. At a multi-layer winding drum, the rope sections spooling in the first layer will also travel around a smooth drum surface, but when the second layer comes in they will be spooled over, compressed and damaged on the upper side by the second rope layer. Rope sections spooling in the second and higher layers will be damaged on all sides. Then they will travel around a very rough surface created by the previous rope layer, leading to wire damage.

CASAR offers the very popular round and triangular six strand standard rope designs that have been used with excellent success. The continuously increasing mine hoist performances as well as economic demands are developing the demands for a suitable hoist rope technology. The CASAR high performance special mining ropes, such as the CASAR Turboplast M, are able to fulfill all kinds of these demands and are able to achieve service life performances that surpass all others.



Rope designs generally suitable for drum winder applications are identified with this symbol.

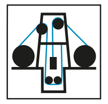
It is fundamental part of CASAR's philosophy to offer its customers not only the highest quality at all times, but also a full technical support, which begins even before a purchase. In order to find the best solution, the correct selection of the product and its characteristics, the following drum winder datasheets are used, please see pages C12/C13.

# SHAFT SINKING

The core component of an underground mining operation is the vertical shaft, either to serve the production, the service and support or the ventilation of the mine. The shaft sinking is another special type of the multi-layer drum winder application.

At a single rope layer drum, the rope travels around smooth, curved surfaces of the same geometry. At a multi-layer winding drum, the rope sections spooling in the first layer will also travel around a smooth drum surface, but when the second layer comes in they will be spooled over, compressed and damaged on the upper side by the second rope layer. Rope sections spooling in the second and higher layers will be damaged on all sides. Then they will travel around a very rough surface created by the previous rope layer, leading to wire damage.

The shaft sinking is one of the most challenging and high-risk operations in underground mining. With this understanding, CASAR offers a comprehensive range of products and expertise to this discipline. The CASAR rope technology including category 1 rotation resistant hoist ropes developed for small drum to rope diameter ratios as well as multiple fall reevings, supply high performance, economic and particularly safe rope solutions to the industry.



Rope designs generally suitable for shaft sinking applications are identified with this symbol.

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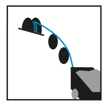
# SLOPE HOISTS

A special type of the drum winder application is the slope mine hoist. Where the drum winder application is hoisting in a vertical mine shaft, the slope mining accesses the mine primarily on an incline. The slope drum winds and unwinds a rope, usually on a single drum, but also on double drum winder machines.

There are single layer and mulit-layer slope drum winders. At a single rope layer drum, the rope travels around smooth, curved surfaces of the same geometry. At a multi-layer winding drum, the rope sections spooling in the first layer will also be travels around a smooth drum surface, but when the second layer comes in they will be spooled over, compressed and damaged on the upper side by the second rope layer. Rope sections spooling in the second and higher layers will be damaged on all sides. Then they will travel around a very rough surface created by the previous rope layer, leading to wire damage.

At a slope mine hoist, the conveyance is moved on a rail system (or kind of). Rollers arranged in equal distances from each other along the route lead the rope and prevent contact with the ground and slack rope. The application therefore makes great demands to a hoist rope, such as a high resistance to abrasion and external damage.

CASAR offers the very popular round and triangular six strand standard rope designs that have been used with excellent success. The continuously increasing mine hoist performances as well as economic demands are developing the demands for a suitable hoist rope technology. The CASAR high performance special mining ropes, such as the CASAR Duroplast M, are able to fulfill all kinds of these demands and are able to achieve service life performances that surpass all others.



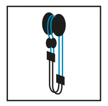
Rope designs generally suitable for slope winder applications are identified with this symbol.

It is a fundamental part of CASAR's philosophy to offer its customers not only the highest quality at all times, but also full technical support, which begins even before a purchase. In order to find the best solution, the correct selection of the product and its characteristics, the following drum winder datasheets are used, please see pages C12/C13.

# KOEPE FRICTION WINDER

Beside the drum winder applications, the most common mine hoist system of the eastern hemisphere countries is the friction winder mine hoist. One advantage of the friction hoists, also known as Koepe winders (named after its inventor Carl Friedrich Koepe), is a larger lift capacity by using several hoisting ropes. The koepe winders are either floor-mounted at the bank level or at the top of a headframe as a shaft-head-mounted machine. In difference to drum winders, the hoist ropes are not connected to the drum, but to both conveyances. The hoisting operation is the result of the transfer of friction between the rope grooves of the Koepe drum (also referred to "traction sheave") and the ropes outer surface. Tail ropes are connected to the bottom side of the conveyances and balance the loads (therefore referred to as balance ropes). With head and tail ropes, the system is in balance and the winder needs to hoist the payload only, which is another advantage of koepe winder machines

CASAR offers the very popular round and triangular six strand standard rope designs that have been used with excellent success. The continuously increasing mine hoist performances as well as economic demands are developing the demands for a suitable hoist rope technology. The CASAR high performance special mining ropes, such as the CASAR Turboplast M, are able to fulfill all kinds of these demands and are able to achieve service life performances that surpass all others. At greater winding distances of more than 800m approx., a rotation resistant rope design is to be used, such as the CASAR Starplast VM.



Rope designs generally suitable for koepe winder applications are identified with this symbol.

It is a fundamental part of CASAR's philosophy to offer its customers not only the highest quality at all times, but also full technical support, which begins even before a purchase. In order to find the best solution, the correct selection of the product and its characteristics, the following koepe winder datasheet are used, please see pages C14/C15.

# UNDERSTANDING YOUR PROJECT

When customers come to CASAR they may be just looking for a rope, but in fact, they are looking for our expertise and hands-on approach to understand and resolve the issues they encounter in the field or their project. Particularly in the mining industry each project is quite unique and needs a dedicated approach in order to find the best solution. Innovative hoisting products from CASAR deliver precisely engineered and custom designed solutions for all challenging mining applications.
Your rope is our passion and we are there to create value and solve problems. This is a task that must be done in teamwork between the mine and CASAR. Our people are an extension of your team to overcome challenges and create solutions for you. Together, we can succeed with a well-established, cost-efficient product selection or we will work out a high performance, customized product solution to maximize the value for money for your service.
Let's start working and challenge our engineers with your project details. As with many activities, a good start is crucial and hence our success begins with a comprehensive collection of the application details. We like to use the following data sheets and sketch to gather the information for a perfect rope selection. Please feel free to fill in as much detail as available or get in contact with us and we will be pleased to go through the specification together.

Data confidentiality is granted and is just used just to find the best high performance rope solution for you.

## General information

mineral

date

pH value

ventilation direction

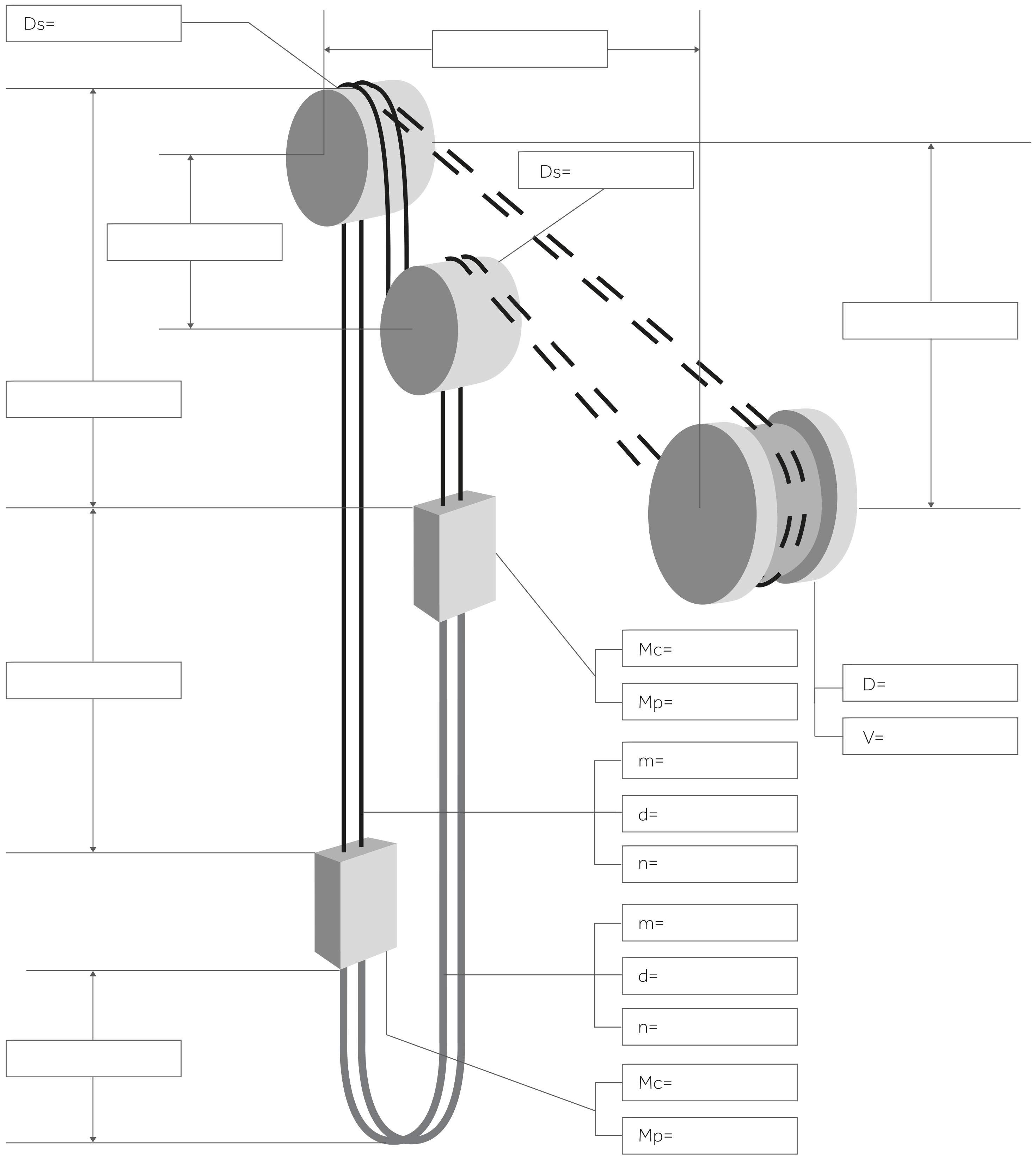
temperature range

chloride content

applicable standards

## Legend

| | | |
|---|---|---|
| Ds | = | sheave diameter |
| D | = | drum diameter |
| Mc | = | mass of conveyance or counterweight incl. attachments |
| Mp | = | mass of payload |
| m | = | rope length mass |
| d | = | rope dimension |
| n | = | number of ropes |
| V | = | hoisting speed |



# DRUM WINDER QUESTIONNAIRE

| **I. Company and Contact Details** | |
|---|---|
| Company Name | |
| Contact Person | |
| Telephone | |
| Email | |
| Name of Mine | |
| Name of Shaft and winder | |
| **II. Winder Specification** | |
| Drum Winder Type (Single, Double or Blair Drum Hoist, cylindrical or conical) | |
| Type of Conveyance Guiding (Rope Guiding, kind and number of ropes) or Rail Guiding (wooden or steel rails) | |
| Type of Hoisting System (Skip-, or Cage-Counterweight, Skip-Skip, Cage-Cage, Single Conveyance, etc.) | |
| Type of Usage (Rock-, Material-, Man Hoisting, Auxiliary or Emergency Purpose) | |
| Diameter of Drum 'D' (mm) | |
| Compartment Width of Drum (mm) | |
| Diameter of Headgear Deflection Sheave 'Ds' (mm) | |
| Type of Drum Coiling Sleeves (e.g. Lebus, Spiral, Flat etc.) | |
| Last Measured Drum Groove Diameter (mm) | |
| Last Measured Drum Groove Pitch (mm) | |
| Last Measured Sheave Groove Diameter (mm) | |
| Type of Sheave Groove Material / Inserts (e.g. Steel grooves, Becoplast, etc.) | |
| Maximum Number of Rope Layers on Drum | |
| Number of Hoist Ropes per Conveyance 'n' (1 or 2) | |
| Mass of Empty Conveyance and Attachments 'Mc' (kg) | |
| Mass of Counterweight and Attachments 'Mc' (kg) if applicable | |
| Payload 'Mp' (kg) | |
| Hoisting Speed / Maximum Rope Speed 'V' (m/s) | |
| Acceleration and Deceleration Speed (m/s²) | |
| Shaft Environment, Flow of Water, PH-Level, Temperature Range | |
| Number of Cycles per Week | |

| **II. Hoist Rope Specification** | |
|---|---|
| Hoist Rope Nominal Length (i.e. rope service length, after rope installation) (m) | |
| Hoist Rope Order Length (m) | |
| Maximum Hoist Rope Suspended Length (m) | |
| Rope Length from drum to sheave (m) | |
| Maximum Hoist Rope Winding Length (m) | |
| Nominal Diameter of Hoist Rope 'd' (mm) | |
| Current used Hoist Rope Standard and Description of Construction | |
| Outer Wire Diameter of current used Hoist Rope (mm) | |
| Hoist Rope Weight per 1m 'm' (kg/m) | |
| Hoist Rope Aggregate Breaking Load of all Wires (kN) | |
| Hoist Rope Minimum Breaking Load (kN) | |
| Hoist Rope Maximum Breaking Load (if applicable) (kN) | |
| Hoist Rope Tensile Strength of Wires (N/mm²) | |
| Hoist Rope Lay Direction | |
| Hoist Rope Wire Finish (galvanized or ungalvanized) | |
| Hoist Rope Lubrication | |
| Type of Hoist Rope Termination to the Conveyance | |
| Required Hoist Rope Factor of Safety (FoS) with reference to Aggregate Breaking Load | |
| OR Required Hoist Rope Capacity Factor with reference to Minimum Breaking Load | |
| Required Hoist Rope Capacity Factor with reference to Aggregate Breaking Load | |
| OR Required Hoist Rope Capacity Factor with reference to Minimum Breaking Load | |
| Current Average Hoist Rope Lifetime (cycles) | |
| Maximum Recorded Hoist Rope Lifetime (cycles) | |
| Minimum Recorded Hoist Rope Lifetime (cycles) | |
| Failure Mode of Hoist Ropes | |

# KOEPE WINDER QUESTIONNAIRE

| **I. Company and Contact Details** | |
|---|---|
| Company Name | |
| Contact Person | |
| Telephone | |
| Email | |
| Name of Mine | |
| Name of Shaft and winder | |
| **II. Winder Specification** | |
| Koepe Winder Type (Tower or Ground Mounted Koepe Drum) | |
| Type of Conveyance Guiding<br>(Rope Guiding, kind and number of ropes) or Rail Guiding (wooden or steel rails) | |
| Type of Hoisting System<br>(Skip-, or Cage-Counterweight, Skip-Skip, Cage-Cage, Single Conveyance, etc.) | |
| Type of Usage (Rock-, Material-, Man Hoisting, Auxiliary or Emergency Purpose) | |
| Diameter of Koepe Drum 'D' (mm) | |
| Angle of Wrap on Koepe Drum (°) | |
| Diameter of Deflection Sheave if installed 'Ds' (mm) | |
| Angle of Wrap on Deflection Sheave (°) | |
| Type of Koepe Drum Groove Insertion (e.g. Becorit K25, Modar etc.) | |
| Type of Sheave Groove Material / Inserts (e.g. Steel grooves, Becoplast, etc.) | |
| Last Measured Koepe Drum Groove Diameter(s) (mm) | |
| Last Measured Sheave Groove Diameter(s) (mm) | |
| Mass of empty Conveyance and Attachments 'Mc' (kg) | |
| Mass of Counterweight and Attachments 'Mc' (kg) if applicable | |
| Payload 'Mp' (kg) | |
| Hoisting Speed / Maximum Rope Speed 'V' (m/s) | |
| Acceleration and Deceleration Speed (m/s²) | |
| Shaft Environment, Flow of Water, PH-Level, Temperature Range | |
| Number of Cycles per week | |

| **II. Hoist Rope Specification** | |
|---|---|
| Number of Hoist Ropes 'n' | |
| Hoist Rope Nominal Length (i.e. rope service length, after rope installation) (m) | |
| Hoist Rope Order Length (m) | |
| Maximum Hoist Rope Suspended Length (m) | |
| Rope Length from drum to sheave (m) | |
| Maximum Hoist Rope Winding Length (m) | |
| Nominal Diameter of Hoist Rope 'd' (mm) | |
| Hoist Rope Standard and Description of Construction | |
| Hoist Rope Weight per 1m 'm' (kg/m) | |
| Hoist Rope Aggregate Breaking Load of all Wires (kN) | |
| Hoist Rope Minimum Breaking Load (kN) | |
| Hoist Rope Maximum Breaking Load (if applicable) (kN) | |
| Hoist Rope Tensile Strength of Wires (N/mm²) | |
| Hoist Rope Lay Direction | |
| Hoist Rope Wire Finish (galvanized or ungalvanized) | |
| Hoist Rope Lubrication | |
| Type of Hoist Rope Termination to the Conveyance | |
| Certified rope nominal diameters for hoist rope attachements (mm) | |
| Required Hoist Rope Factor of Safety (FoS) with reference to Aggregate Breaking Load | |
| OR Required Hoist Rope Capacity Factor with reference to Minimum Breaking Load | |
| Required Hoist Rope Capacity Factor with reference to Aggregate Breaking Load | |
| OR Required Hoist Rope Capacity Factor with reference to Minimum Breaking Load | |
| Failure Mode of Hoist Ropes | |
| Current Average Hoist Rope Lifetime (cycles) | |
| Maximum Recorded Hoist Rope Lifetime (cycles) | |
| Minimum Recorded Hoist Rope Lifetime (cycles) | |

# ROPE LIFE RECORD IN A SOUTH AFRICAN PLATINUM MINE

**The service life of wire rope in Mine Winding is critically important, not only due to the high cost of materials, but more importantly the down time in production during a failure or changeover. Ropes from Casar have already saved Millions of Dollars for Mining Operations all around the world.**

Casar has been a leader in the development and production of high-performance ropes for underground mining since its foundation in 1948. The clearly defined task has always been to increase the service life of the ropes used in order to be able to extend the replacement intervals and hence save money for the mine. At the same time, the CASAR engineers are pursuing the goal of placing the safety reserves in an area that is optimal for mining operations until they are ready for discard. Larger intervals for changing the rope must never be at the expense of operational safety!

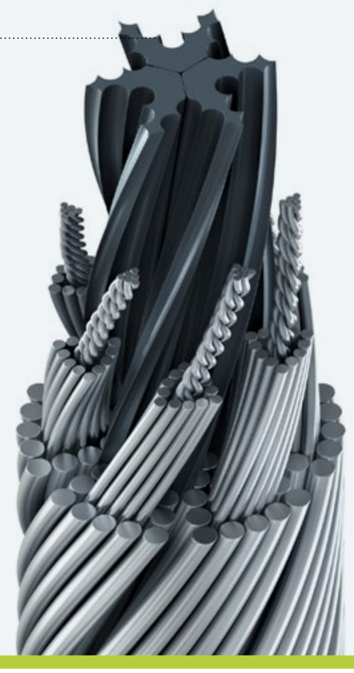
A milestone in this challenging task was the introduction of the plastic-coated rope core. Here Casar has taken a unique approach in which a closed plastic layer is extruded in a special work step. This protects the rope core from penetrating dirt and moisture and seals the important lubricant for the entire life of the rope. But an additional effect that the plastic has is just as important. By avoiding steel / steel contact between the outer strands, friction and thus wear are greatly reduced. Special plastic materials and lubricants optimize these special Casar rope constructions. In this South African platinum mine, too, the aim was to extend the service life and thus the rope replacement intervals. Traditionally, triangular strand ropes were used in this mine, which averaged a service life of 16.7 months and 116,800 cycles. The Casar experts suggested a Turboplast M, a compacted eight-strand rope with a plastic-coated heart. This proven construction is characterized by good wear resistance, pressure stability and a long service life. Casar countered the higher price of the rope with a performance guarantee of 36 months. The reality has far exceeded this assumption. The rope was discarded after 57 months and 402,000 cycles. That is almost 3.5 times the original rope life!

**Turboplast M Lifetime:**
57 Months
**Turboplast M Cycles:**
402,000 Cycles

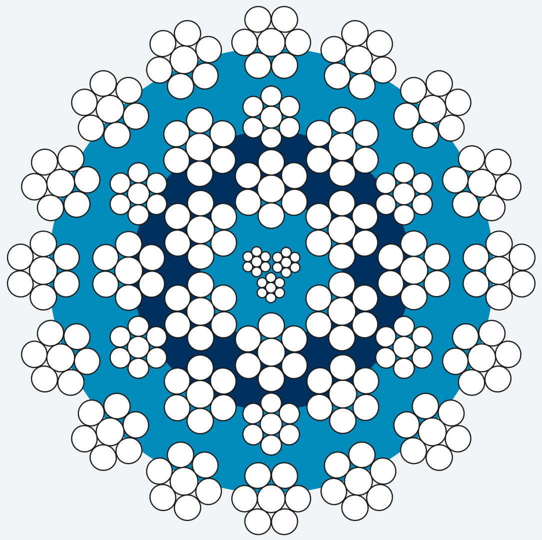
## 3.4 TIMES LONGER SERVICE LIFE

### COST SAVING TOTAL: 50% LESS FOR TURBOPLAST M

**Original Lifetime:**
16.7 Months
**Original Cycles:**
116,800 Cycles

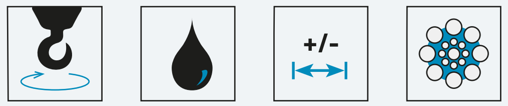


# CASAR STARPLAST M



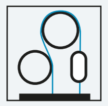
- High performance mining rope
- Category 1 rotation resistant
- Fully lubricated
- Plastic layer between steel core and outer strands
- High breaking force
- Available in ordinary (regular) lay or langs lay

## PROPERTIES



Swivel Lubricated Tolerance Plast rope

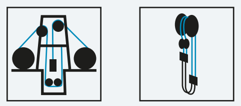




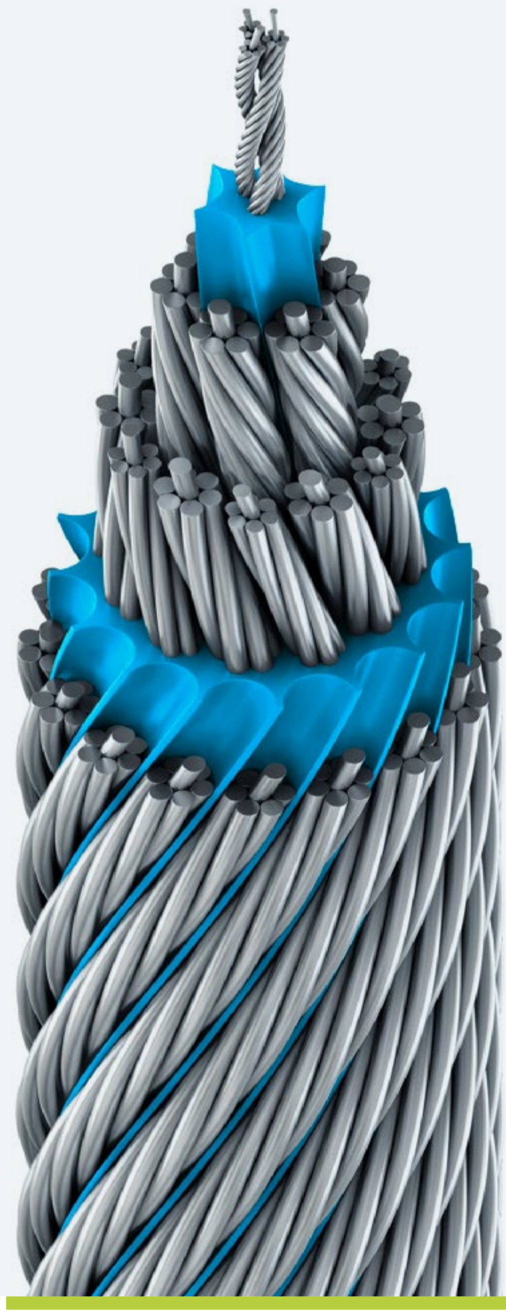
Ultra Deep

## APPLICATIONS

High performance hoist rope for drum and particularly for koepe friction winder applications, where rotation-resistant ropes are required. Rope design and manufacturing parameters are adjusted according to the application, i.e. Starplast MD and Starplast MF. The Starplast M with conventional strands offers a very high fatigue resistance. This design is continuously improved, particularly the inner elements, to achieve the optimum strand-to-strand contact conditions and to offer the best possible service life. Less recommended for multi-layer drum winder applications.



Shaft Sinking Koepe Winder head rope

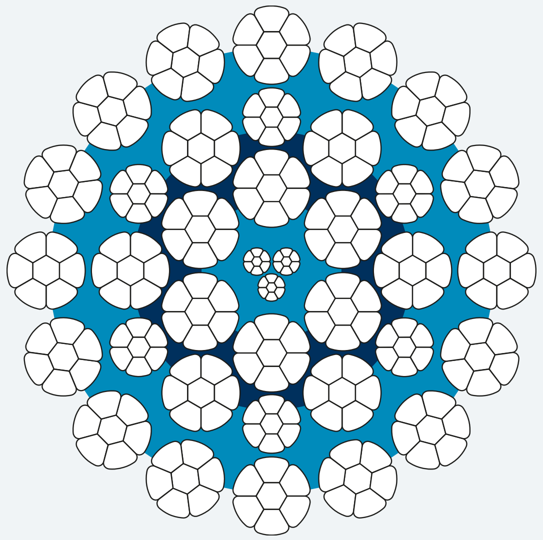


| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force 1770 N/mm² | | Aggregate Breaking Force 1960 N/mm² | | Minimum Breaking Force 1770 N/mm² | | Minimum Breaking Force 1960 N/mm² | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 198.3 | 0.3074 | 1.77 | 1.19 | 351.0 | 78,917 | 388.7 | 87,389 | 287.9 | 64,712 | 318.8 | 71,659 |
| 21 | | 218.7 | 0.3389 | 1.95 | 1.31 | 387.0 | 87,006 | 428.6 | 96,346 | 317.4 | 71,345 | 351.4 | 79,004 |
| 22 | | 240.0 | 0.3720 | 2.14 | 1.44 | 424.8 | 95,490 | 470.4 | 105,740 | 348.3 | 78,302 | 385.7 | 86,707 |
| | 7/8 | 244.9 | 0.3796 | 2.19 | 1.47 | 433.5 | 97,453 | 480.0 | 107,914 | 355.5 | 79,912 | 393.6 | 88,490 |
| 23 | | 262.3 | 0.4065 | 2.34 | 1.57 | 464.3 | 104,368 | 514.1 | 115,572 | 380.7 | 85,582 | 421.6 | 94,769 |
| 24 | | 285.6 | 0.4427 | 2.55 | 1.71 | 505.5 | 113,641 | 559.8 | 125,840 | 414.5 | 93,186 | 459.0 | 103,189 |
| 25 | | 309.9 | 0.4803 | 2.77 | 1.86 | 548.5 | 123,308 | 607.4 | 136,545 | 449.8 | 101,113 | 498.1 | 111,967 |
| | 1 | 319.9 | 0.4958 | 2.86 | 1.92 | 566.2 | 127,286 | 627.0 | 140,949 | 464.3 | 104,374 | 514.1 | 115,578 |
| 26 | | 335.2 | 0.5195 | 2.99 | 2.01 | 593.3 | 133,370 | 656.9 | 147,687 | 486.5 | 109,364 | 538.7 | 121,103 |
| 27 | | 361.5 | 0.5603 | 3.23 | 2.17 | 639.8 | 143,827 | 708.5 | 159,266 | 524.6 | 117,938 | 580.9 | 130,598 |
| 28 | | 388.7 | 0.6025 | 3.47 | 2.33 | 688.0 | 154,678 | 761.9 | 171,282 | 564.2 | 126,836 | 624.8 | 140,451 |
| | 1 1/8 | 404.9 | 0.6275 | 3.62 | 2.43 | 716.6 | 161,096 | 793.5 | 178,389 | 587.6 | 132,099 | 650.7 | 146,279 |
| 29 | | 417.0 | 0.6463 | 3.73 | 2.50 | 738.1 | 165,924 | 817.3 | 183,735 | 605.2 | 136,057 | 670.2 | 150,662 |
| 30 | | 446.2 | 0.6917 | 3.99 | 2.68 | 789.8 | 177,564 | 874.6 | 196,625 | 647.7 | 145,602 | 717.2 | 161,232 |
| 31 | | 476.5 | 0.7386 | 4.26 | 2.86 | 843.4 | 189,599 | 933.9 | 209,951 | 691.6 | 155,471 | 765.8 | 172,160 |
| | 1 1/4 | 499.8 | 0.7747 | 4.47 | 3.00 | 884.7 | 198,884 | 979.6 | 220,233 | 725.4 | 163,085 | 803.3 | 180,591 |
| 32 | | 507.7 | 0.7870 | 4.54 | 3.05 | 898.7 | 202,028 | 995.1 | 223,715 | 736.9 | 165,663 | 816.0 | 183,446 |
| 33 | | 540.0 | 0.8369 | 4.82 | 3.24 | 955.7 | 214,852 | 1,058.3 | 237,916 | 783.7 | 176,179 | 867.8 | 195,091 |
| 34 | | 573.2 | 0.8884 | 5.12 | 3.44 | 1,014.5 | 228,071 | 1,123.4 | 252,553 | 831.9 | 187,018 | 921.2 | 207,094 |
| 35 | 1 3/8 | 604.8 | 0.9374 | 5.40 | 3.63 | 1,070.5 | 240,650 | 1,185.4 | 266,482 | 877.8 | 197,333 | 972.0 | 218,515 |
| 36 | | 642.6 | 0.9960 | 5.74 | 3.86 | 1,137.4 | 255,692 | 1,259.5 | 283,139 | 932.6 | 209,668 | 1,032.8 | 232,174 |
| 37 | | 678.8 | 1.0521 | 6.06 | 4.07 | 1,201.4 | 270,095 | 1,330.4 | 299,088 | 985.2 | 221,478 | 1,090.9 | 245,252 |
| 38 | | 716.0 | 1.1097 | 6.40 | 4.30 | 1,267.3 | 284,892 | 1,403.3 | 315,473 | 1,039.2 | 233,611 | 1,150.7 | 258,688 |
| | 1 1/2 | 719.7 | 1.1156 | 6.43 | 4.32 | 1,273.9 | 286,393 | 1,410.7 | 317,136 | 1,044.6 | 234,842 | 1,156.8 | 260,051 |
| 39 | | 754.1 | 1.1689 | 6.74 | 4.53 | 1,334.8 | 300,083 | 1,478.1 | 332,295 | 1,094.6 | 246,068 | 1,212.1 | 272,482 |
| 40 | | 793.3 | 1.2296 | 7.09 | 4.76 | 1,404.2 | 315,669 | 1,554.9 | 349,555 | 1,151.4 | 258,849 | 1,275.0 | 286,635 |
| 41 | | 833.5 | 1.2919 | 7.45 | 5.00 | 1,475.3 | 331,650 | 1,633.6 | 367,251 | 1,209.7 | 271,953 | 1,339.6 | 301,146 |
| | 1 5/8 | 844.7 | 1.3093 | 7.55 | 5.07 | 1,495.1 | 336,114 | 1,655.6 | 372,194 | 1,226.0 | 275,613 | 1,357.6 | 305,199 |
| 42 | | 874.6 | 1.3557 | 7.81 | 5.25 | 1,548.1 | 348,025 | 1,714.3 | 385,384 | 1,269.4 | 285,381 | 1,405.7 | 316,015 |
| 43 | | 916.8 | 1.4210 | 8.19 | 5.50 | 1,622.7 | 364,795 | 1,796.9 | 403,954 | 1,330.6 | 299,132 | 1,473.4 | 331,242 |
| 44 | | 959.9 | 1.4879 | 8.58 | 5.76 | 1,699.0 | 381,960 | 1,881.4 | 422,961 | 1,393.2 | 313,207 | 1,542.8 | 346,828 |
| | 1 3/4 | 979.6 | 1.5185 | 8.75 | 5.88 | 1,734.0 | 389,813 | 1,920.1 | 431,657 | 1,421.9 | 319,646 | 1,574.5 | 353,959 |
| 45 | | 1,004.0 | 1.5563 | 8.97 | 6.03 | 1,777.1 | 399,519 | 1,967.9 | 442,405 | 1,457.3 | 327,606 | 1,613.7 | 362,772 |
| 46 | | 1,049.2 | 1.6262 | 9.37 | 6.30 | 1,857.0 | 417,473 | 2,056.4 | 462,286 | 1,522.7 | 342,328 | 1,686.2 | 379,075 |
| | 1 7/8 | 1,124.6 | 1.7431 | 10.05 | 6.75 | 1,990.5 | 447,489 | 2,204.2 | 495,525 | 1,632.2 | 366,941 | 1,807.4 | 406,330 |
| 47 | | 1,095.3 | 1.6977 | 9.79 | 6.58 | 1,938.6 | 435,821 | 2,146.7 | 482,604 | 1,589.7 | 357,373 | 1,760.3 | 395,735 |
| 48 | | 1,142.4 | 1.7707 | 10.21 | 6.86 | 2,022.0 | 454,564 | 2,239.1 | 503,359 | 1,658.0 | 372,742 | 1,836.0 | 412,754 |
| 49 | | 1,190.5 | 1.8452 | 10.64 | 7.15 | 2,107.1 | 473,701 | 2,333.3 | 524,551 | 1,727.8 | 388,435 | 1,913.3 | 430,132 |
| 50 | | 1,239.6 | 1.9213 | 11.07 | 7.44 | 2,194.0 | 493,233 | 2,429.5 | 546,179 | 1,799.1 | 404,451 | 1,992.2 | 447,867 |
| | 2 | 1,279.5 | 1.9833 | 11.43 | 7.68 | 2,264.8 | 509,143 | 2,507.9 | 563,797 | 1,857.1 | 417,497 | 2,056.5 | 462,313 |
| 51 | | 1,289.6 | 1.9989 | 11.52 | 7.74 | 2,282.6 | 513,160 | 2,527.7 | 568,245 | 1,871.8 | 420,791 | 2,072.7 | 465,961 |
| 52 | | 1,340.7 | 2.0781 | 11.98 | 8.05 | 2,373.0 | 533,481 | 2,627.8 | 590,748 | 1,945.9 | 437,455 | 2,154.8 | 484,413 |
| 53 | | 1,392.8 | 2.1588 | 12.44 | 8.36 | 2,465.2 | 554,197 | 2,729.8 | 613,687 | 2,021.5 | 454,442 | 2,238.4 | 503,223 |
| 54 | 2 1/8 | 1,444.5 | 2.2389 | 12.90 | 8.67 | 2,556.7 | 574,775 | 2,831.2 | 636,474 | 2,096.5 | 471,315 | 2,321.6 | 521,909 |
| 55 | | 1,499.9 | 2.3248 | 13.40 | 9.00 | 2,654.8 | 596,812 | 2,939.7 | 660,877 | 2,176.9 | 489,386 | 2,410.6 | 541,919 |
| 56 | | 1,554.9 | 2.4101 | 13.89 | 9.33 | 2,752.2 | 618,712 | 3,047.6 | 685,127 | 2,256.8 | 507,344 | 2,499.0 | 561,804 |
| 57 | | 1,610.9 | 2.4969 | 14.39 | 9.67 | 2,851.3 | 641,006 | 3,157.4 | 709,815 | 2,338.1 | 525,625 | 2,589.1 | 582,048 |
| | 2 1/4 | 1,619.4 | 2.5101 | 14.47 | 9.72 | 2,866.4 | 644,384 | 3,174.1 | 713,555 | 2,350.4 | 528,395 | 2,602.7 | 585,115 |
| 58 | | 1,667.9 | 2.5853 | 14.90 | 10.01 | 2,952.3 | 663,695 | 3,269.2 | 734,939 | 2,420.9 | 544,230 | 2,680.7 | 602,650 |
| 59 | | 1,726.0 | 2.6752 | 15.42 | 10.36 | 3,054.9 | 686,778 | 3,382.9 | 760,500 | 2,505.1 | 563,158 | 2,774.0 | 623,610 |
| 60 | | 1,785.0 | 2.7667 | 15.95 | 10.72 | 3,159.4 | 710,256 | 3,498.5 | 786,498 | 2,590.7 | 582,410 | 2,868.8 | 644,929 |
| | 2 3/8 | 1,804.3 | 2.7967 | 16.12 | 10.83 | 3,193.7 | 717,971 | 3,536.5 | 795,042 | 2,618.8 | 588,736 | 2,899.9 | 651,934 |
| 61 | | 1,845.0 | 2.8597 | 16.48 | 11.08 | 3,265.6 | 734,129 | 3,616.1 | 812,933 | 2,677.8 | 601,985 | 2,965.2 | 666,605 |
| 62 | | 1,905.9 | 2.9542 | 17.03 | 11.44 | 3,373.5 | 758,396 | 3,735.6 | 839,805 | 2,766.3 | 621,884 | 3,063.2 | 688,640 |
| 63 | | 1,967.9 | 3.0503 | 17.58 | 11.81 | 3,483.2 | 783,057 | 3,857.1 | 867,114 | 2,856.2 | 642,107 | 3,162.8 | 711,034 |
| | 2 ½ | 1,999.3 | 3.0989 | 17.86 | 12.00 | 3,538.7 | 795,536 | 3,918.6 | 880,933 | 2,901.8 | 652,340 | 3,213.2 | 722,365 |
| 64 | | 2,030.9 | 3.1479 | 18.14 | 12.19 | 3,594.7 | 808,114 | 3,980.5 | 894,860 | 2,947.6 | 662,653 | 3,264.0 | 733,785 |
| 65 | | 2,094.8 | 3.2470 | 18.72 | 12.58 | 3,707.9 | 833,564 | 4,105.9 | 923,043 | 3,040.5 | 683,523 | 3,366.8 | 756,895 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

Special constructions and diameters available – please contact us directly.

# CASAR **STARPLAST VM**



- High performance mining rope
- Category 1 rotation resistant
- Fully lubricated
- Plastic layer between steel core and outer strands
- Very high breaking force
- Good resistance to drum crushing
- Available in ordinary (regular) lay or langs lay

IMPROVED DESIGN

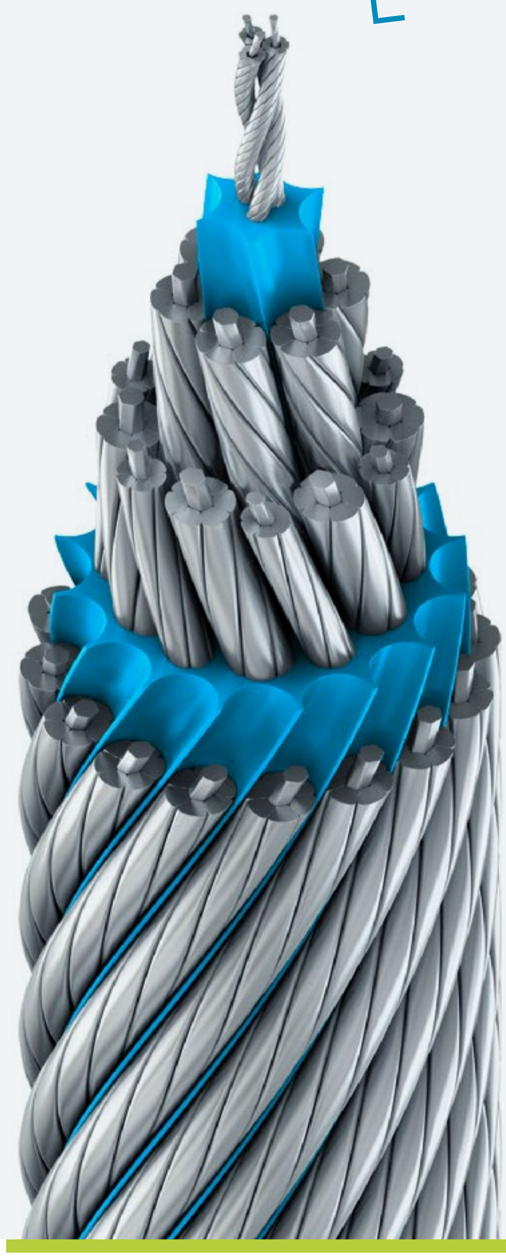
## PROPERTIES

Swivel | Lubricated | Tolerance | Plast rope | Compacted | Ultra Deep

## APPLICATIONS

High performance hoist rope for drum and for koepe friction winder applications, where rotation-resistant ropes are required. Rope design and manufacturing parameters are adjusted according to the application, i.e. Starplast VMD and Starplast VMF. The Starplast VM with compacted strands offers a very high fatigue resistance as well as a good resistance to drum crushing. This design is continuously improved, particularly the inner elements, to achieve the optimum strand-to-strand contact conditions and to offer the best possible service life.

Drum Winder | Shaft Sinking | Koepe Winder head rope

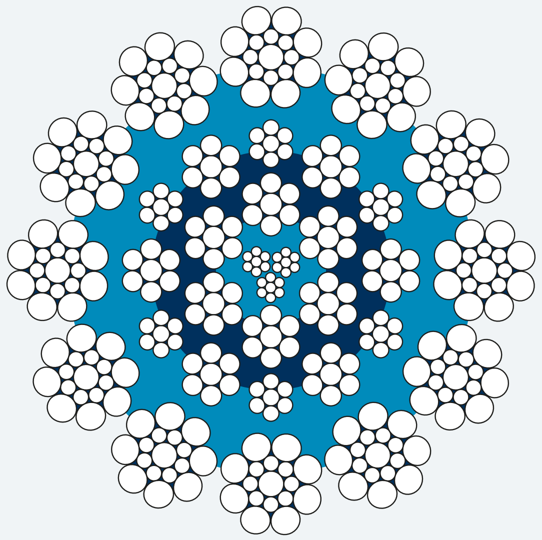


| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force | | | | Minimum Breaking Force | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1770 N/mm² | | 1960 N/mm² | | 1770 N/mm² | | 1960 N/mm² | |
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 216.3 | 0.3352 | 1.89 | 1.27 | 382.8 | 86,055 | 423.9 | 95,293 | 307.6 | 69,151 | 340.6 | 76,570 |
| 21 | | 238.4 | 0.3696 | 2.08 | 1.40 | 422.0 | 94,876 | 467.3 | 105,060 | 339.1 | 76,233 | 375.5 | 84,416 |
| 22 | | 261.7 | 0.4056 | 2.29 | 1.54 | 463.2 | 104,127 | 512.9 | 115,304 | 372.2 | 83,674 | 412.1 | 92,644 |
| | 7/8 | 267.1 | 0.4139 | 2.33 | 1.57 | 472.7 | 106,268 | 523.4 | 117,675 | 379.9 | 85,394 | 420.6 | 94,548 |
| 23 | | 286.0 | 0.4433 | 2.50 | 1.68 | 506.2 | 113,808 | 560.6 | 126,025 | 406.8 | 91,452 | 450.5 | 101,276 |
| 24 | | 311.4 | 0.4827 | 2.72 | 1.83 | 551.2 | 123,920 | 610.4 | 137,222 | 442.9 | 99,568 | 490.5 | 110,269 |
| 25 | | 337.9 | 0.5238 | 2.95 | 1.98 | 598.1 | 134,461 | 662.3 | 148,895 | 480.6 | 108,043 | 532.2 | 119,643 |
| | 1 | 348.8 | 0.5407 | 3.05 | 2.05 | 617.4 | 138,799 | 683.7 | 153,698 | 496.1 | 111,528 | 549.4 | 123,503 |
| 26 | | 365.5 | 0.5665 | 3.19 | 2.14 | 646.9 | 145,433 | 716.4 | 161,045 | 519.8 | 116,856 | 575.6 | 129,400 |
| 27 | | 394.1 | 0.6109 | 3.44 | 2.31 | 697.6 | 156,836 | 772.5 | 173,671 | 560.6 | 126,028 | 620.8 | 139,561 |
| 28 | | 423.9 | 0.6570 | 3.70 | 2.49 | 750.3 | 168,668 | 830.8 | 186,774 | 602.9 | 135,537 | 667.6 | 150,082 |
| | 1 1/8 | 441.5 | 0.6843 | 3.86 | 2.59 | 781.4 | 175,667 | 865.3 | 194,524 | 627.9 | 141,161 | 695.3 | 156,310 |
| 29 | | 454.7 | 0.7048 | 3.97 | 2.67 | 804.8 | 180,931 | 891.2 | 200,353 | 646.7 | 145,384 | 716.1 | 160,986 |
| 30 | | 486.6 | 0.7542 | 4.25 | 2.86 | 861.3 | 193,624 | 953.7 | 214,409 | 692.1 | 155,590 | 766.4 | 172,294 |
| 31 | | 519.6 | 0.8054 | 4.54 | 3.05 | 919.7 | 206,748 | 1,018.4 | 228,941 | 739.0 | 166,134 | 818.3 | 183,961 |
| | 1 1/4 | 545.0 | 0.8448 | 4.76 | 3.20 | 964.7 | 216,873 | 1,068.3 | 240,153 | 775.2 | 174,270 | 858.4 | 192,970 |
| 32 | | 553.6 | 0.8581 | 4.83 | 3.25 | 980.0 | 220,302 | 1,085.1 | 243,950 | 787.5 | 177,037 | 872.0 | 196,033 |
| 33 | | 588.8 | 0.9126 | 5.14 | 3.46 | 1,042.2 | 234,285 | 1,154.0 | 259,435 | 837.4 | 188,255 | 927.3 | 208,465 |
| 34 | | 625.0 | 0.9688 | 5.46 | 3.67 | 1,106.3 | 248,700 | 1,225.0 | 275,396 | 889.0 | 199,855 | 984.4 | 221,302 |
| 35 | 1 3/8 | 659.5 | 1.0222 | 5.76 | 3.87 | 1,167.3 | 262,416 | 1,292.6 | 290,585 | 942.0 | 211,770 | 1,043.1 | 234,498 |
| 36 | | 700.7 | 1.0861 | 6.12 | 4.11 | 1,240.2 | 278,819 | 1,373.4 | 308,749 | 996.6 | 224,045 | 1,103.6 | 248,099 |
| 37 | | 740.2 | 1.1473 | 6.46 | 4.34 | 1,310.1 | 294,524 | 1,450.7 | 326,140 | 1,052.8 | 236,679 | 1,165.8 | 262,082 |
| 38 | | 780.7 | 1.2101 | 6.82 | 4.58 | 1,381.9 | 310,660 | 1,530.2 | 344,007 | 1,110.4 | 249,628 | 1,229.6 | 276,425 |
| | 1 1/2 | 784.8 | 1.2165 | 6.85 | 4.61 | 1,389.2 | 312,297 | 1,538.3 | 345,820 | 1,116.3 | 250,943 | 1,236.1 | 277,882 |
| 39 | | 822.4 | 1.2747 | 7.18 | 4.83 | 1,455.6 | 327,225 | 1,611.8 | 362,351 | 1,169.6 | 262,936 | 1,295.2 | 291,172 |
| 40 | | 865.1 | 1.3409 | 7.55 | 5.08 | 1,531.2 | 344,221 | 1,695.5 | 381,171 | 1,230.4 | 276,605 | 1,362.5 | 306,302 |
| 41 | | 908.9 | 1.4087 | 7.94 | 5.33 | 1,608.7 | 361,647 | 1,781.4 | 400,468 | 1,292.7 | 290,610 | 1,431.4 | 321,791 |
| | 1 5/8 | 921.1 | 1.4277 | 8.04 | 5.41 | 1,630.3 | 366,515 | 1,805.3 | 405,858 | 1,310.1 | 294,522 | 1,450.7 | 326,123 |
| 42 | | 953.7 | 1.4783 | 8.33 | 5.60 | 1,688.1 | 379,504 | 1,869.3 | 420,241 | 1,356.5 | 304,953 | 1,502.1 | 337,685 |
| 43 | | 999.7 | 1.5495 | 8.73 | 5.87 | 1,769.5 | 397,791 | 1,959.4 | 440,491 | 1,421.9 | 319,656 | 1,574.5 | 353,962 |
| 44 | | 1,046.7 | 1.6224 | 9.14 | 6.14 | 1,852.7 | 416,508 | 2,051.6 | 461,217 | 1,488.8 | 334,695 | 1,648.6 | 370,620 |
| | 1 3/4 | 1,068.3 | 1.6558 | 9.33 | 6.27 | 1,890.8 | 425,071 | 2,093.8 | 470,700 | 1,519.4 | 341,577 | 1,682.5 | 378,240 |
| 45 | | 1,094.9 | 1.6970 | 9.56 | 6.42 | 1,937.9 | 435,655 | 2,145.9 | 482,420 | 1,557.2 | 350,072 | 1,724.4 | 387,660 |
| 46 | | 1,144.1 | 1.7733 | 9.99 | 6.71 | 2,025.0 | 455,232 | 2,242.3 | 504,099 | 1,627.2 | 365,809 | 1,801.9 | 405,083 |
| | 1 7/8 | 1,226.3 | 1.9008 | 10.71 | 7.20 | 2,170.6 | 487,964 | 2,403.6 | 540,344 | 1,744.2 | 392,111 | 1,931.5 | 434,209 |
| 47 | | 1,194.3 | 1.8512 | 10.43 | 7.01 | 2,114.0 | 475,240 | 2,340.9 | 526,255 | 1,698.7 | 381,883 | 1,881.1 | 422,888 |
| 48 | | 1,245.7 | 1.9308 | 10.88 | 7.31 | 2,204.9 | 495,678 | 2,441.6 | 548,887 | 1,771.8 | 398,316 | 1,962.0 | 441,075 |
| 49 | | 1,298.1 | 2.0121 | 11.34 | 7.62 | 2,297.7 | 516,547 | 2,544.4 | 571,995 | 1,846.4 | 415,087 | 2,044.6 | 459,644 |
| 50 | | 1,351.7 | 2.0951 | 11.80 | 7.93 | 2,392.5 | 537,845 | 2,649.3 | 595,580 | 1,922.5 | 432,195 | 2,128.9 | 478,596 |
| | 2 | 1,395.3 | 2.1627 | 12.18 | 8.19 | 2,469.6 | 555,194 | 2,734.7 | 614,791 | 1,984.5 | 446,136 | 2,197.6 | 494,033 |
| 51 | | 1,406.3 | 2.1797 | 12.28 | 8.25 | 2,489.1 | 559,574 | 2,756.3 | 619,642 | 2,000.2 | 449,663 | 2,214.9 | 497,929 |
| 52 | | 1,462.0 | 2.2660 | 12.77 | 8.58 | 2,587.7 | 581,734 | 2,865.5 | 644,180 | 2,079.4 | 467,468 | 2,302.6 | 517,645 |
| 53 | | 1,518.7 | 2.3540 | 13.26 | 8.91 | 2,688.2 | 604,323 | 2,976.7 | 669,194 | 2,160.1 | 485,610 | 2,392.0 | 537,743 |
| 54 | 2 1/8 | 1,575.1 | 2.4414 | 13.76 | 9.24 | 2,788.0 | 626,762 | 3,087.3 | 694,042 | 2,242.4 | 504,111 | 2,483.1 | 558,223 |
| 55 | | 1,635.5 | 2.5351 | 14.28 | 9.60 | 2,894.9 | 650,793 | 3,205.6 | 720,652 | 2,326.2 | 522,950 | 2,575.9 | 579,085 |
| 56 | | 1,695.5 | 2.6281 | 14.81 | 9.95 | 3,001.1 | 674,673 | 3,323.2 | 747,096 | 2,411.6 | 542,149 | 2,670.4 | 600,330 |
| 57 | | 1,756.6 | 2.7228 | 15.34 | 10.31 | 3,109.2 | 698,984 | 3,443.0 | 774,016 | 2,498.5 | 561,685 | 2,766.7 | 621,979 |
| | 2 1/4 | 1,765.9 | 2.7371 | 15.42 | 10.36 | 3,125.6 | 702,668 | 3,461.1 | 778,095 | 2,511.7 | 564,645 | 2,781.3 | 625,257 |
| 58 | | 1,818.8 | 2.8192 | 15.88 | 10.67 | 3,219.3 | 723,725 | 3,564.9 | 801,413 | 2,586.9 | 581,558 | 2,864.6 | 643,988 |
| 59 | | 1,882.1 | 2.9172 | 16.44 | 11.04 | 3,331.3 | 748,896 | 3,688.8 | 829,286 | 2,676.9 | 601,791 | 2,964.2 | 666,379 |
| 60 | | 1,946.4 | 3.0169 | 17.00 | 11.42 | 3,445.1 | 774,497 | 3,815.0 | 857,636 | 2,768.4 | 622,361 | 3,065.6 | 689,174 |
| | 2 3/8 | 1,967.5 | 3.0497 | 17.18 | 11.55 | 3,482.6 | 782,911 | 3,856.4 | 866,952 | 2,798.5 | 629,128 | 3,098.9 | 696,660 |
| 61 | | 2,011.8 | 3.1183 | 17.57 | 11.81 | 3,560.9 | 800,529 | 3,943.2 | 886,462 | 2,861.4 | 643,268 | 3,168.6 | 712,329 |
| 62 | | 2,078.3 | 3.2214 | 18.15 | 12.20 | 3,678.6 | 826,991 | 4,073.5 | 915,764 | 2,956.0 | 664,535 | 3,273.4 | 735,889 |
| 63 | | 2,145.9 | 3.3262 | 18.74 | 12.59 | 3,798.3 | 853,883 | 4,206.0 | 945,543 | 3,052.2 | 686,162 | 3,379.8 | 759,809 |
| | 2 ½ | 2,180.1 | 3.3792 | 19.04 | 12.79 | 3,858.8 | 867,491 | 4,273.0 | 960,611 | 3,100.8 | 697,087 | 3,433.7 | 771,926 |
| 64 | | 2,214.6 | 3.4326 | 19.34 | 13.00 | 3,919.8 | 881,206 | 4,340.6 | 975,799 | 3,149.8 | 708,103 | 3,488.0 | 784,133 |
| 65 | | 2,284.3 | 3.5407 | 19.95 | 13.41 | 4,043.3 | 908,959 | 4,477.3 | 1,006,531 | 3,249.0 | 730,404 | 3,597.8 | 808,817 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

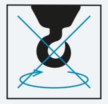
Special constructions and diameters available – please contact us directly.

# CASAR **MINEPLAST M**

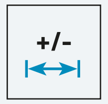


- High performance mining rope
- Rotation resistant
- Fully lubricated
- Plastic layer between steel core and outer strands
- High breaking force
- Available in ordinary (regular) lay or langs lay

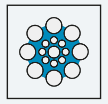
## PROPERTIES

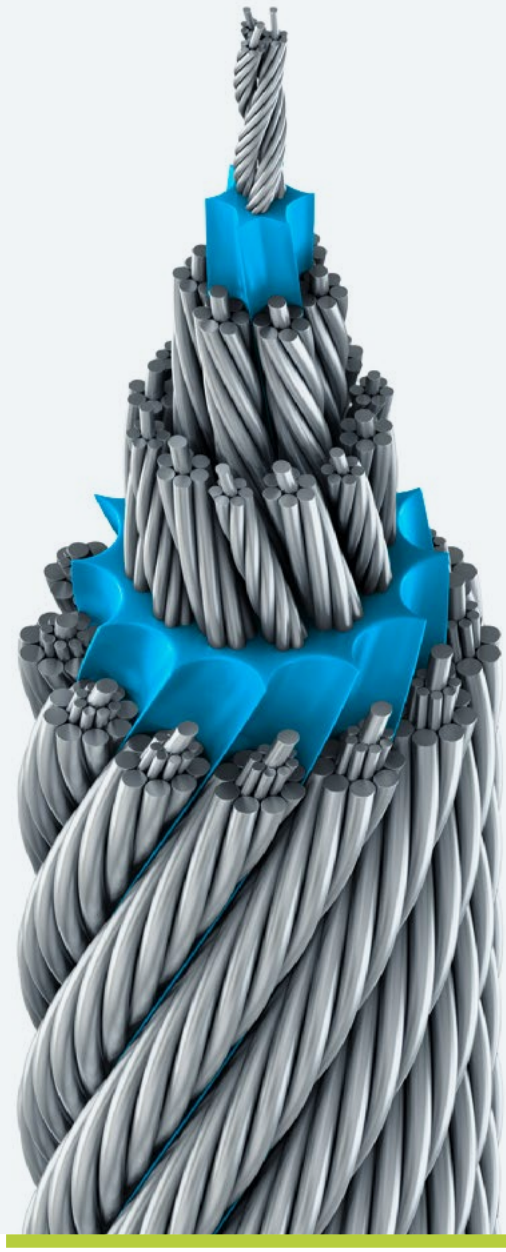

No swivel


Lubricated



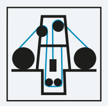
Tolerance


Plast rope



## APPLICATIONS

High performance hoist rope for drum and particularly for koepe friction winder applications, where rotation-resistant ropes are required. Rope design and manufacturing parameters are adjusted according to the application, i.e. Mineplast MD and Mineplast MF. The Mineplast M with conventional strands offers a very high fatigue resistance. This design is continuously improved, particularly the inner elements, to achieve the optimum strand-to-strand contact conditions and to offer the best possible service life. Less recommended for multi-layer drum winder applications.


Shaft Sinking


Koepe Winder head rope

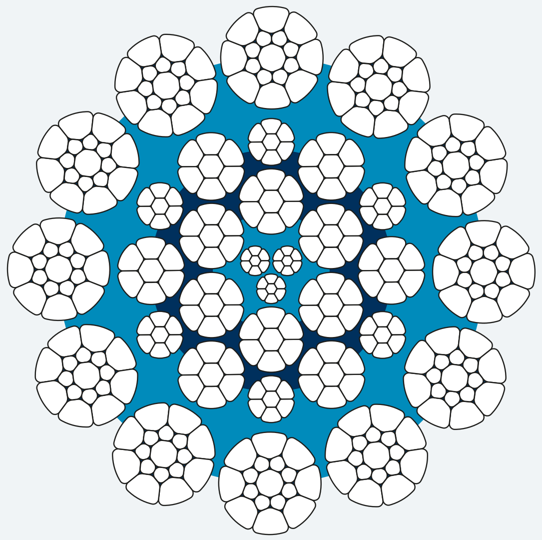


| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force | | | | Minimum Breaking Force | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1770 N/mm² | | 1960 N/mm² | | 1770 N/mm² | | 1960 N/mm² | |
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 195.6 | 0.3032 | 1.75 | 1.18 | 346.3 | 77,842 | 383.4 | 86,198 | 272.6 | 61,283 | 301.8 | 67,847 |
| 21 | | 215.7 | 0.3343 | 1.93 | 1.30 | 381.8 | 85,821 | 422.7 | 95,034 | 300.5 | 67,555 | 332.8 | 74,816 |
| 22 | | 236.7 | 0.3669 | 2.12 | 1.42 | 419.0 | 94,189 | 463.9 | 104,300 | 329.8 | 74,142 | 365.2 | 82,100 |
| | 7/8 | 241.6 | 0.3744 | 2.16 | 1.45 | 427.6 | 96,126 | 473.5 | 106,444 | 336.6 | 75,666 | 372.7 | 83,788 |
| 23 | | 258.7 | 0.4010 | 2.32 | 1.56 | 457.9 | 102,946 | 507.1 | 113,997 | 360.5 | 81,044 | 399.2 | 89,744 |
| 24 | | 281.7 | 0.4366 | 2.52 | 1.70 | 498.6 | 112,093 | 552.1 | 124,125 | 392.5 | 88,237 | 434.6 | 97,702 |
| 25 | | 305.7 | 0.4738 | 2.74 | 1.84 | 541.0 | 121,629 | 599.1 | 134,685 | 425.9 | 95,746 | 471.6 | 106,020 |
| | 1 | 315.5 | 0.4891 | 2.83 | 1.90 | 558.5 | 125,552 | 618.4 | 139,029 | 439.6 | 98,834 | 486.8 | 109,440 |
| 26 | | 330.6 | 0.5124 | 2.96 | 1.99 | 585.2 | 131,553 | 648.0 | 145,675 | 460.6 | 103,547 | 510.1 | 114,675 |
| 27 | | 356.5 | 0.5526 | 3.19 | 2.15 | 631.1 | 141,868 | 698.8 | 157,096 | 496.7 | 111,663 | 550.1 | 123,667 |
| 28 | | 383.4 | 0.5943 | 3.43 | 2.31 | 678.7 | 152,571 | 751.5 | 168,949 | 534.2 | 120,093 | 591.6 | 132,997 |
| | 1 1/8 | 399.3 | 0.6190 | 3.58 | 2.40 | 706.8 | 158,901 | 782.7 | 175,959 | 556.4 | 125,076 | 616.1 | 138,515 |
| 29 | | 411.3 | 0.6375 | 3.68 | 2.48 | 728.0 | 163,663 | 806.2 | 181,232 | 573.1 | 128,838 | 634.6 | 142,664 |
| 30 | | 440.2 | 0.6822 | 3.94 | 2.65 | 779.1 | 175,145 | 862.7 | 193,946 | 613.3 | 137,875 | 679.1 | 152,668 |
| 31 | | 470.0 | 0.7285 | 4.21 | 2.83 | 831.9 | 187,016 | 921.2 | 207,091 | 654.8 | 147,205 | 725.1 | 163,009 |
| | 1 1/4 | 493.0 | 0.7642 | 4.42 | 2.97 | 872.6 | 196,175 | 966.3 | 217,233 | 686.9 | 154,414 | 760.6 | 170,992 |
| 32 | | 500.8 | 0.7762 | 4.49 | 3.01 | 886.4 | 199,276 | 981.6 | 220,667 | 697.8 | 156,872 | 772.7 | 173,710 |
| 33 | | 532.6 | 0.8255 | 4.77 | 3.21 | 942.7 | 211,926 | 1,043.9 | 234,675 | 742.0 | 166,808 | 821.7 | 184,725 |
| 34 | | 565.4 | 0.8763 | 5.06 | 3.40 | 1,000.7 | 224,964 | 1,108.1 | 249,113 | 787.7 | 177,082 | 872.3 | 196,101 |
| 35 | 1 3/8 | 596.5 | 0.9246 | 5.34 | 3.59 | 1,055.9 | 237,371 | 1,169.2 | 262,852 | 834.7 | 187,648 | 924.3 | 207,791 |
| 36 | | 633.8 | 0.9824 | 5.68 | 3.82 | 1,121.9 | 252,209 | 1,242.3 | 279,282 | 883.1 | 198,529 | 977.9 | 219,841 |
| 37 | | 669.5 | 1.0378 | 6.00 | 4.03 | 1,185.1 | 266,415 | 1,312.3 | 295,013 | 932.8 | 209,702 | 1,033.0 | 232,228 |
| 38 | | 706.2 | 1.0946 | 6.33 | 4.25 | 1,250.0 | 281,011 | 1,384.2 | 311,176 | 983.9 | 221,189 | 1,089.6 | 244,952 |
| | 1 1/2 | 709.9 | 1.1004 | 6.36 | 4.27 | 1,256.6 | 282,492 | 1,391.5 | 312,816 | 989.1 | 222,355 | 1,095.3 | 246,243 |
| 39 | | 743.9 | 1.1530 | 6.66 | 4.48 | 1,316.7 | 295,995 | 1,458.0 | 327,769 | 1,036.4 | 232,992 | 1,147.7 | 258,013 |
| 40 | | 782.5 | 1.2129 | 7.01 | 4.71 | 1,385.0 | 311,369 | 1,533.7 | 344,793 | 1,090.2 | 245,087 | 1,207.3 | 271,412 |
| 41 | | 822.1 | 1.2743 | 7.36 | 4.95 | 1,455.2 | 327,132 | 1,611.4 | 362,248 | 1,145.4 | 257,496 | 1,268.4 | 285,148 |
| 42 | | 862.7 | 1.3372 | 7.73 | 5.19 | 1,527.0 | 343,284 | 1,690.9 | 380,134 | 1,202.0 | 270,220 | 1,331.0 | 299,221 |
| | 1 5/8 | 833.2 | 1.2914 | 7.46 | 5.02 | 1,474.7 | 331,535 | 1,633.0 | 367,124 | 1,160.9 | 260,972 | 1,285.4 | 288,980 |
| 43 | | 904.3 | 1.4016 | 8.10 | 5.44 | 1,600.6 | 359,826 | 1,772.4 | 398,451 | 1,259.9 | 283,237 | 1,395.2 | 313,653 |
| 44 | | 946.8 | 1.4676 | 8.48 | 5.70 | 1,675.9 | 376,757 | 1,855.8 | 417,199 | 1,319.2 | 296,568 | 1,460.8 | 328,401 |
| | 1 3/4 | 966.3 | 1.4978 | 8.66 | 5.82 | 1,710.4 | 384,502 | 1,893.9 | 425,777 | 1,346.3 | 302,665 | 1,490.8 | 335,152 |
| 45 | | 990.4 | 1.5351 | 8.87 | 5.96 | 1,752.9 | 394,077 | 1,941.1 | 436,379 | 1,379.8 | 310,191 | 1,528.0 | 343,508 |
| 46 | | 1,034.9 | 1.6040 | 9.27 | 6.23 | 1,831.7 | 411,786 | 2,028.3 | 455,989 | 1,441.8 | 324,129 | 1,596.6 | 358,930 |
| 47 | | 1,080.3 | 1.6745 | 9.68 | 6.50 | 1,912.2 | 429,884 | 2,117.5 | 476,030 | 1,505.2 | 338,382 | 1,666.8 | 374,711 |
| | 1 7/8 | 1,109.3 | 1.7194 | 9.94 | 6.68 | 1,963.4 | 441,393 | 2,174.2 | 488,774 | 1,545.5 | 347,442 | 1,711.4 | 384,743 |
| 48 | | 1,126.8 | 1.7466 | 10.09 | 6.78 | 1,994.5 | 448,371 | 2,208.6 | 496,502 | 1,569.9 | 352,927 | 1,738.5 | 390,830 |
| 49 | | 1,174.3 | 1.8201 | 10.52 | 7.07 | 2,078.4 | 467,248 | 2,301.5 | 517,405 | 1,636.0 | 367,787 | 1,811.7 | 407,286 |
| 50 | | 1,222.7 | 1.8951 | 10.95 | 7.36 | 2,164.1 | 486,514 | 2,396.4 | 538,739 | 1,703.5 | 382,962 | 1,886.4 | 424,080 |
| | 2 | 1,262.1 | 1.9563 | 11.31 | 7.60 | 2,233.9 | 502,207 | 2,473.7 | 556,116 | 1,758.4 | 395,315 | 1,947.2 | 437,759 |
| 51 | | 1,272.1 | 1.9717 | 11.40 | 7.66 | 2,251.6 | 506,169 | 2,493.2 | 560,504 | 1,772.3 | 398,429 | 1,962.6 | 441,210 |
| 52 | | 1,322.4 | 2.0498 | 11.85 | 7.96 | 2,340.7 | 526,214 | 2,592.0 | 582,700 | 1,842.5 | 414,210 | 2,040.3 | 458,678 |
| 53 | | 1,373.8 | 2.1294 | 12.31 | 8.27 | 2,431.6 | 546,647 | 2,692.6 | 605,327 | 1,914.1 | 430,307 | 2,119.5 | 476,482 |
| 54 | 2 1/8 | 1,424.8 | 2.2084 | 12.76 | 8.58 | 2,521.9 | 566,945 | 2,792.6 | 627,803 | 1,987.0 | 446,695 | 2,200.3 | 494,647 |
| 55 | | 1,479.4 | 2.2931 | 13.25 | 8.91 | 2,618.6 | 588,682 | 2,899.7 | 651,874 | 2,061.2 | 463,376 | 2,282.5 | 513,126 |
| 56 | | 1,533.7 | 2.3773 | 13.74 | 9.23 | 2,714.7 | 610,283 | 3,006.1 | 675,794 | 2,136.9 | 480,394 | 2,366.3 | 531,965 |
| 57 | 2 1/4 | 1,597.4 | 2.4759 | 14.31 | 9.62 | 2,827.3 | 635,606 | 3,130.8 | 703,835 | 2,213.9 | 497,704 | 2,451.5 | 551,119 |
| 58 | | 1,645.2 | 2.5501 | 14.74 | 9.90 | 2,912.0 | 654,654 | 3,224.6 | 724,927 | 2,292.2 | 515,307 | 2,538.3 | 570,632 |
| 59 | | 1,702.4 | 2.6388 | 15.25 | 10.25 | 3,013.3 | 677,422 | 3,336.8 | 750,140 | 2,372.0 | 533,247 | 2,626.6 | 590,483 |
| 60 | | 1,760.6 | 2.7290 | 15.77 | 10.60 | 3,116.3 | 700,580 | 3,450.9 | 775,784 | 2,453.0 | 551,456 | 2,716.4 | 610,671 |
| | 2 3/8 | 1,779.8 | 2.7586 | 15.94 | 10.71 | 3,150.2 | 708,191 | 3,488.3 | 784,211 | 2,479.6 | 557,436 | 2,745.9 | 617,303 |
| 61 | | 1,819.8 | 2.8207 | 16.30 | 10.95 | 3,221.1 | 724,128 | 3,566.8 | 801,859 | 2,535.4 | 569,980 | 2,807.7 | 631,196 |
| 62 | | 1,880.0 | 2.9140 | 16.84 | 11.32 | 3,327.6 | 748,064 | 3,684.8 | 828,365 | 2,619.3 | 588,842 | 2,900.5 | 652,058 |
| 63 | | 1,941.1 | 3.0087 | 17.39 | 11.68 | 3,435.8 | 772,390 | 3,804.6 | 855,302 | 2,704.4 | 607,973 | 2,994.8 | 673,258 |
| | 2 ½ | 1,972.0 | 3.0567 | 17.67 | 11.87 | 3,490.5 | 784,699 | 3,865.2 | 868,932 | 2,747.5 | 617,662 | 3,042.6 | 684,004 |
| 64 | | 2,003.2 | 3.1050 | 17.94 | 12.06 | 3,545.7 | 797,105 | 3,926.3 | 882,670 | 2,791.0 | 627,442 | 3,090.7 | 694,817 |
| 65 | | 2,066.3 | 3.2028 | 18.51 | 12.44 | 3,657.4 | 822,209 | 4,050.0 | 910,469 | 2,878.9 | 647,202 | 3,188.0 | 716,691 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

Special constructions and diameters available – please contact us directly.

# CASAR **MINEPLAST VM**



- High performance mining rope
- Rotation resistant
- Fully lubricated
- Plastic layer between steel core and outer strands
- Very high breaking force
- Good resistance to drum crushing
- Available in ordinary (regular) lay or langs lay

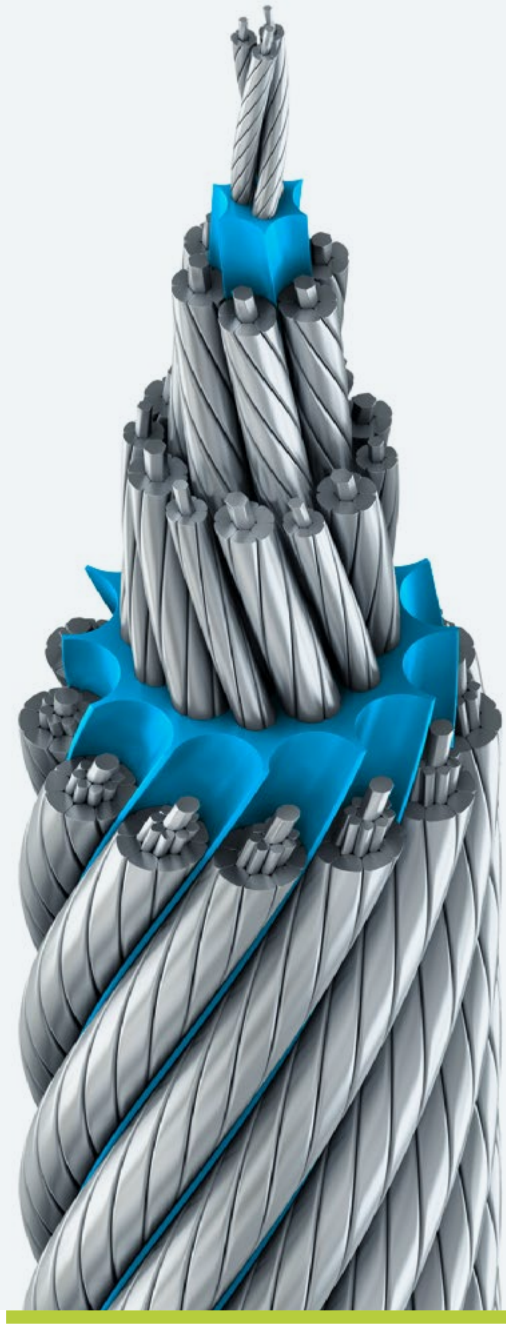
## PROPERTIES

No swivel | Lubricated | Tolerance (+/-) | Plast rope | Compacted (COMPACT)

## APPLICATIONS

High performance hoist rope for drum and for koepe friction winder applications, where rotation-resistant ropes are required. Rope design and manufacturing parameters are adjusted according to the application, i.e. Mineplast VMD and Mineplast VMF. The Mineplast VM with compacted strands offers a very high fatigue resistance as well as a good resistance to drum crushing. This design is continuously improved, particularly the inner elements, to achieve the optimum strand-to-strand contact conditions and to offer the best possible service life.

Drum Winder | Shaft Sinking | Koepe Winder head rope

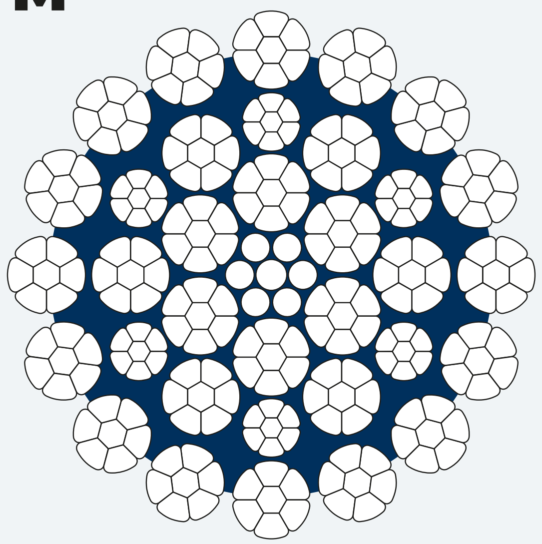


| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force | | | | Minimum Breaking Force | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1770 N/mm² | | 1960 N/mm² | | 1770 N/mm² | | 1960 N/mm² | |
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 213.5 | 0.3309 | 1.84 | 1.24 | 377.9 | 84,955 | 418.5 | 94,075 | 297.6 | 66,903 | 329.6 | 74,097 |
| 21 | | 235.4 | 0.3648 | 2.03 | 1.37 | 416.6 | 93,663 | 461.4 | 103,717 | 328.1 | 73,760 | 363.4 | 81,696 |
| 22 | | 258.3 | 0.4004 | 2.23 | 1.50 | 457.3 | 102,796 | 506.3 | 113,830 | 360.1 | 80,954 | 398.8 | 89,654 |
| | 7/8 | 263.6 | 0.4087 | 2.28 | 1.53 | 466.7 | 104,909 | 516.8 | 116,171 | 367.4 | 82,595 | 407.2 | 91,542 |
| 23 | | 282.4 | 0.4377 | 2.44 | 1.64 | 499.8 | 112,353 | 553.4 | 124,414 | 393.6 | 88,485 | 435.9 | 97,994 |
| 24 | | 307.4 | 0.4765 | 2.66 | 1.78 | 544.2 | 122,336 | 602.6 | 135,468 | 428.6 | 96,353 | 474.6 | 106,694 |
| 25 | | 333.6 | 0.5171 | 2.88 | 1.94 | 590.5 | 132,743 | 653.9 | 146,992 | 465.0 | 104,536 | 515.0 | 115,777 |
| | 1 | 344.4 | 0.5338 | 2.97 | 2.00 | 609.5 | 137,024 | 674.9 | 151,733 | 480.0 | 107,908 | 531.6 | 119,511 |
| 26 | | 360.8 | 0.5593 | 3.12 | 2.09 | 638.7 | 143,574 | 707.2 | 158,986 | 503.0 | 113,079 | 557.0 | 125,219 |
| 27 | | 389.1 | 0.6031 | 3.36 | 2.26 | 688.7 | 154,831 | 762.7 | 171,451 | 542.4 | 121,936 | 600.7 | 135,043 |
| 28 | | 418.5 | 0.6486 | 3.61 | 2.43 | 740.7 | 166,512 | 820.2 | 184,386 | 583.3 | 131,131 | 646.0 | 145,227 |
| | 1 1/8 | 435.8 | 0.6755 | 3.76 | 2.53 | 771.4 | 173,421 | 854.2 | 192,037 | 607.5 | 136,572 | 672.8 | 151,252 |
| 29 | | 448.9 | 0.6958 | 3.88 | 2.61 | 794.5 | 178,618 | 879.8 | 197,792 | 625.8 | 140,685 | 692.9 | 155,770 |
| 30 | | 480.4 | 0.7446 | 4.15 | 2.79 | 850.3 | 191,149 | 941.5 | 211,668 | 669.7 | 150,555 | 741.5 | 166,696 |
| 31 | | 512.9 | 0.7951 | 4.43 | 2.98 | 907.9 | 204,105 | 1,005.4 | 226,014 | 715.0 | 160,738 | 791.8 | 178,004 |
| 32 | 1 1/4 | 538.1 | 0.8340 | 4.65 | 3.12 | 952.4 | 214,100 | 1,054.6 | 237,083 | 761.9 | 171,282 | 843.7 | 189,671 |
| 33 | | 581.3 | 0.9010 | 5.02 | 3.37 | 1,028.8 | 231,291 | 1,139.3 | 256,118 | 810.3 | 182,163 | 897.3 | 201,721 |
| 34 | | 617.0 | 0.9564 | 5.33 | 3.58 | 1,092.1 | 245,521 | 1,209.4 | 271,876 | 860.1 | 193,358 | 952.5 | 214,130 |
| 35 | | 653.9 | 1.0135 | 5.65 | 3.79 | 1,157.3 | 260,175 | 1,281.5 | 288,104 | 911.5 | 204,913 | 1,009.3 | 226,900 |
| 36 | 1 3/8 | 651.1 | 1.0091 | 5.62 | 3.78 | 1,152.4 | 259,061 | 1,276.1 | 286,870 | 964.3 | 216,783 | 1,067.8 | 240,051 |
| 37 | | 730.7 | 1.1326 | 6.31 | 4.24 | 1,293.4 | 290,759 | 1,432.2 | 321,971 | 1,018.6 | 228,990 | 1,128.0 | 253,584 |
| 38 | 1 1/2 | 774.8 | 1.2009 | 6.69 | 4.50 | 1,371.4 | 308,305 | 1,518.6 | 341,399 | 1,074.4 | 241,535 | 1,189.8 | 267,478 |
| 39 | | 811.8 | 1.2584 | 7.01 | 4.71 | 1,437.0 | 323,042 | 1,591.2 | 357,719 | 1,131.7 | 254,416 | 1,253.2 | 281,731 |
| 40 | | 854.0 | 1.3237 | 7.38 | 4.96 | 1,511.6 | 339,821 | 1,673.9 | 376,299 | 1,190.5 | 267,635 | 1,318.3 | 296,366 |
| 41 | | 897.2 | 1.3907 | 7.75 | 5.21 | 1,588.1 | 357,024 | 1,758.6 | 395,349 | 1,250.8 | 281,191 | 1,385.0 | 311,360 |
| | 1 5/8 | 909.3 | 1.4094 | 7.85 | 5.28 | 1,609.5 | 361,830 | 1,782.3 | 400,670 | 1,267.6 | 284,976 | 1,403.6 | 315,551 |
| 42 | | 941.5 | 1.4594 | 8.13 | 5.46 | 1,666.5 | 374,652 | 1,845.4 | 414,869 | 1,312.5 | 295,062 | 1,453.4 | 326,737 |
| 43 | | 986.9 | 1.5297 | 8.52 | 5.73 | 1,746.8 | 392,705 | 1,934.4 | 434,860 | 1,375.8 | 309,292 | 1,523.5 | 342,496 |
| 44 | | 1,033.4 | 1.6017 | 8.93 | 6.00 | 1,829.0 | 411,183 | 2,025.4 | 455,322 | 1,440.5 | 323,837 | 1,595.1 | 358,593 |
| | 1 3/4 | 1,054.6 | 1.6346 | 9.11 | 6.12 | 1,866.6 | 419,637 | 2,067.0 | 464,683 | 1,470.1 | 330,495 | 1,627.9 | 365,965 |
| 45 | | 1,080.9 | 1.6753 | 9.34 | 6.27 | 1,913.1 | 430,086 | 2,118.5 | 476,253 | 1,506.7 | 338,720 | 1,668.5 | 375,094 |
| 46 | | 1,129.4 | 1.7506 | 9.75 | 6.55 | 1,999.1 | 449,413 | 2,213.7 | 497,655 | 1,574.4 | 353,939 | 1,743.5 | 391,954 |
| 47 | | 1,179.1 | 1.8276 | 10.18 | 6.84 | 2,087.0 | 469,165 | 2,311.0 | 519,527 | 1,643.6 | 369,496 | 1,820.1 | 409,175 |
| | 1 7/8 | 1,210.6 | 1.8765 | 10.46 | 7.03 | 2,142.8 | 481,726 | 2,372.8 | 533,437 | 1,687.6 | 379,388 | 1,868.8 | 420,129 |
| 48 | | 1,229.8 | 1.9062 | 10.62 | 7.14 | 2,176.7 | 489,342 | 2,410.4 | 541,870 | 1,714.3 | 385,390 | 1,898.4 | 426,777 |
| 49 | | 1,281.5 | 1.9864 | 11.07 | 7.44 | 2,268.3 | 509,944 | 2,511.8 | 564,683 | 1,786.5 | 401,621 | 1,978.3 | 444,739 |
| 50 | | 1,334.4 | 2.0683 | 11.53 | 7.74 | 2,361.9 | 530,970 | 2,615.4 | 587,967 | 1,860.2 | 418,190 | 2,059.8 | 463,061 |
| 51 | 2 | 1,377.4 | 2.1350 | 11.90 | 7.99 | 2,438.1 | 548,097 | 2,699.8 | 606,932 | 1,935.3 | 435,073 | 2,143.1 | 481,788 |
| 52 | | 1,443.3 | 2.2371 | 12.47 | 8.38 | 2,554.6 | 574,297 | 2,828.8 | 635,945 | 2,012.0 | 452,316 | 2,227.9 | 500,852 |
| 53 | | 1,499.3 | 2.3239 | 12.95 | 8.70 | 2,653.8 | 596,598 | 2,938.7 | 660,640 | 2,090.1 | 469,873 | 2,314.4 | 520,298 |
| 54 | 2 1/8 | 1,555.0 | 2.4102 | 13.43 | 9.02 | 2,752.3 | 618,750 | 3,047.8 | 685,170 | 2,169.7 | 487,768 | 2,402.6 | 540,126 |
| 55 | | 1,614.6 | 2.5027 | 13.95 | 9.37 | 2,857.9 | 642,474 | 3,164.6 | 711,440 | 2,250.8 | 506,000 | 2,492.4 | 560,314 |
| 56 | | 1,673.9 | 2.5945 | 14.46 | 9.71 | 2,962.7 | 666,049 | 3,280.8 | 737,546 | 2,333.4 | 524,569 | 2,583.9 | 580,884 |
| 57 | 2 1/4 | 1,743.3 | 2.7021 | 15.06 | 10.12 | 3,085.7 | 693,685 | 3,416.9 | 768,149 | 2,417.5 | 543,476 | 2,677.0 | 601,813 |
| 58 | | 1,795.6 | 2.7831 | 15.51 | 10.42 | 3,178.1 | 714,473 | 3,519.3 | 791,168 | 2,503.0 | 562,697 | 2,771.7 | 623,103 |
| 59 | | 1,858.0 | 2.8799 | 16.05 | 10.78 | 3,288.7 | 739,323 | 3,641.7 | 818,685 | 2,590.1 | 582,278 | 2,868.1 | 644,774 |
| 60 | | 1,921.5 | 2.9784 | 16.60 | 11.15 | 3,401.1 | 764,597 | 3,766.2 | 846,672 | 2,678.6 | 602,173 | 2,966.2 | 666,828 |
| | 2 3/8 | 1,942.4 | 3.0107 | 16.78 | 11.27 | 3,438.0 | 772,902 | 3,807.1 | 855,869 | 2,707.6 | 608,693 | 2,998.4 | 674,067 |
| 61 | | 1,986.1 | 3.0785 | 17.15 | 11.53 | 3,515.4 | 790,296 | 3,892.8 | 875,130 | 2,768.5 | 622,383 | 3,065.9 | 689,242 |
| 62 | | 2,051.8 | 3.1802 | 17.72 | 11.91 | 3,631.6 | 816,420 | 4,021.5 | 904,058 | 2,860.0 | 642,953 | 3,167.2 | 712,015 |
| 63 | | 2,118.5 | 3.2836 | 18.30 | 12.30 | 3,749.7 | 842,968 | 4,152.2 | 933,456 | 2,953.0 | 663,861 | 3,270.2 | 735,170 |
| | 2 ½ | 2,152.2 | 3.3360 | 18.59 | 12.49 | 3,809.5 | 856,402 | 4,218.4 | 948,332 | 3,000.1 | 674,449 | 3,322.3 | 746,883 |
| 64 | | 2,186.3 | 3.3887 | 18.88 | 12.69 | 3,869.7 | 869,941 | 4,285.1 | 963,325 | 3,047.5 | 685,105 | 3,374.9 | 758,708 |
| 65 | | 2,255.1 | 3.4954 | 19.48 | 13.09 | 3,991.6 | 897,339 | 4,420.0 | 993,664 | 3,143.5 | 706,687 | 3,481.2 | 782,605 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

Special constructions and diameters available – please contact us directly.

# CASAR **STARLIFT PLUS M**



- High performance mining rope
- Category 1 rotation resistant
- Fully lubricated
- Extremely high breaking force
- Good resistance to drum crushing
- Available in ordinary (regular) lay or langs lay

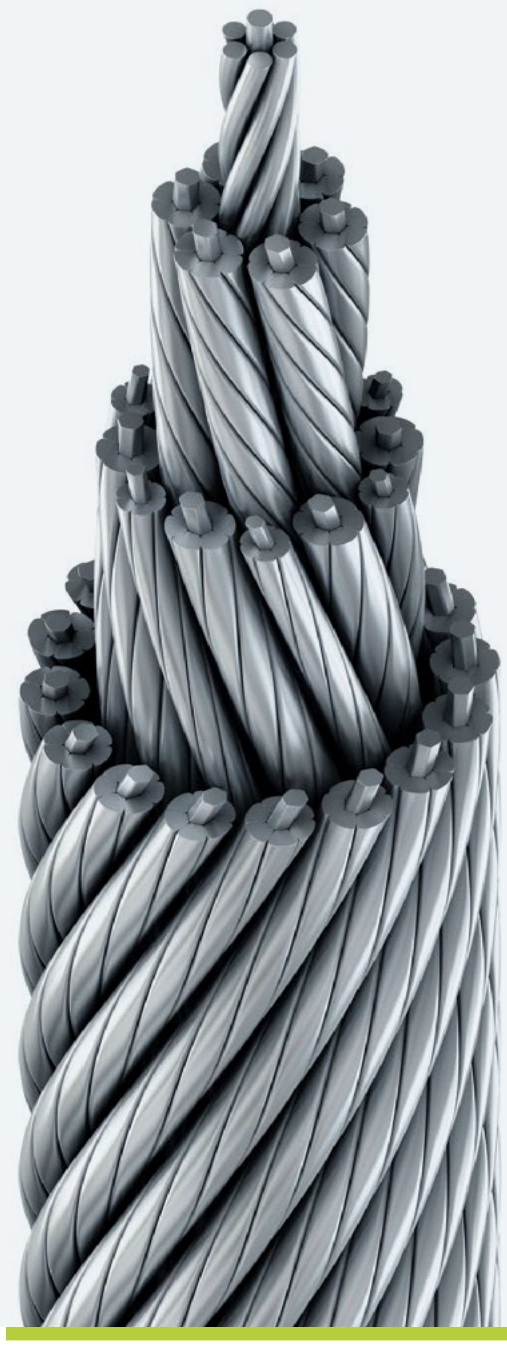
## PROPERTIES

No swivel
Lubricated
+/- Tolerance
COMPACT Compacted
kN High Breaking Force

## APPLICATIONS

High performance hoist rope for drum, koepe friction winder and particularly shaft sinking applications, where rotation-resistant ropes are required. Rope design and manufacturing parameters are adjusted according to the application, i.e. Starlift Plus MD and Starlift Plus MF. The Starlift Plus M with compacted strands offers a very high fatigue resistance as well as a good resistance to drum crushing. It is a very flexible rope with a specially designed core avoiding crossovers between the strands of core and preventing internal rope degradation.

Drum Winder
Shaft Sinking
Koepe Winder head rope

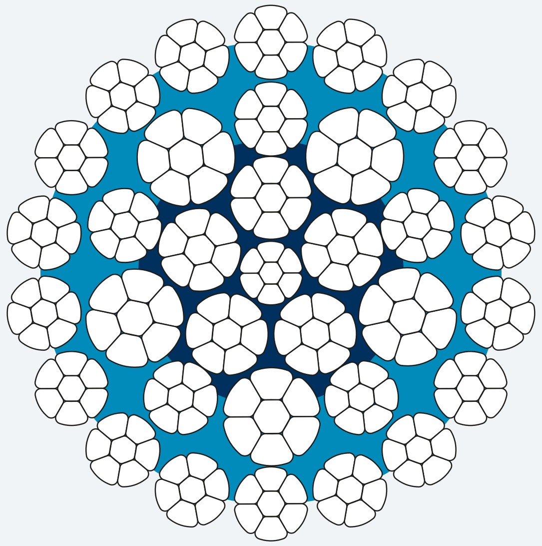


| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force 1770 N/mm² | | Aggregate Breaking Force 1960 N/mm² | | Minimum Breaking Force 1770 N/mm² | | Minimum Breaking Force 1960 N/mm² | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 225.6 | 0.3497 | 1.98 | 1.33 | 399.3 | 89,769 | 442.2 | 99,405 | 332.0 | 74,637 | 367.0 | 82,505 |
| 21 | | 247.3 | 0.3833 | 2.17 | 1.46 | 437.7 | 98,404 | 484.7 | 108,967 | 364.0 | 81,830 | 402.0 | 90,373 |
| 22 | | 271.8 | 0.4213 | 2.39 | 1.61 | 481.1 | 108,152 | 532.7 | 119,762 | 400.0 | 89,924 | 442.0 | 99,366 |
| | 7/8 | 277.4 | 0.4300 | 2.44 | 1.64 | 491.0 | 110,381 | 543.7 | 122,229 | 408.2 | 91,776 | 451.1 | 101,413 |
| 23 | | 296.9 | 0.4602 | 2.61 | 1.75 | 525.5 | 118,140 | 581.9 | 130,822 | 437.0 | 98,241 | 483.0 | 108,583 |
| 24 | | 322.5 | 0.4999 | 2.83 | 1.90 | 570.8 | 128,327 | 632.1 | 142,102 | 475.0 | 106,795 | 525.0 | 118,025 |
| 25 | | 350.5 | 0.5433 | 3.08 | 2.07 | 620.4 | 139,468 | 687.0 | 154,439 | 516.0 | 116,001 | 571.0 | 128,366 |
| | 1 | 361.8 | 0.5608 | 3.18 | 2.14 | 640.4 | 143,964 | 709.1 | 159,418 | 532.6 | 119,741 | 589.4 | 132,504 |
| 26 | | 377.7 | 0.5854 | 3.32 | 2.23 | 668.5 | 150,291 | 740.3 | 166,424 | 556.0 | 124,994 | 615.0 | 138,257 |
| 27 | | 410.9 | 0.6369 | 3.61 | 2.43 | 727.3 | 163,502 | 805.4 | 181,053 | 605.0 | 136,009 | 669.0 | 150,397 |
| 28 | | 441.4 | 0.6842 | 3.88 | 2.61 | 781.3 | 175,638 | 865.1 | 194,492 | 650.0 | 146,126 | 719.0 | 161,638 |
| | 1 1/8 | 459.7 | 0.7125 | 4.04 | 2.71 | 813.7 | 182,920 | 901.0 | 202,556 | 676.9 | 152,184 | 748.8 | 168,339 |
| 29 | | 471.8 | 0.7313 | 4.15 | 2.79 | 835.1 | 187,735 | 924.7 | 207,887 | 694.0 | 156,017 | 768.0 | 172,653 |
| 30 | | 508.1 | 0.7876 | 4.47 | 3.00 | 899.3 | 202,179 | 995.9 | 223,882 | 748.0 | 168,157 | 827.0 | 185,917 |
| 31 | | 539.8 | 0.8367 | 4.75 | 3.19 | 955.4 | 214,793 | 1,058.0 | 237,850 | 795.0 | 178,721 | 879.0 | 197,607 |
| | 1 1/4 | 566.2 | 0.8776 | 4.98 | 3.35 | 1,002.2 | 225,298 | 1,109.8 | 249,482 | 833.9 | 187,462 | 922.0 | 207,271 |
| 32 | | 573.4 | 0.8888 | 5.04 | 3.39 | 1,014.9 | 228,163 | 1,123.9 | 252,655 | 844.0 | 189,739 | 934.0 | 209,972 |
| 33 | | 616.1 | 0.9550 | 5.42 | 3.64 | 1,090.5 | 245,153 | 1,207.6 | 271,469 | 907.0 | 203,902 | 1,003.0 | 225,483 |
| 34 | | 647.1 | 1.0030 | 5.69 | 3.82 | 1,145.4 | 257,489 | 1,268.3 | 285,129 | 953.0 | 214,243 | 1,054.0 | 236,949 |
| | 1 3/8 | 682.8 | 1.0583 | 6.00 | 4.03 | 1,208.6 | 271,694 | 1,338.3 | 300,859 | 1,005.6 | 226,062 | 1,112.1 | 250,021 |
| 36 | | 729.2 | 1.1303 | 6.54 | 4.39 | 1,290.7 | 290,157 | 1,429.2 | 321,304 | 1,074.0 | 241,441 | 1,187.0 | 266,848 |
| 38 | | 812.0 | 1.2586 | 7.31 | 4.91 | 1,437.2 | 323,104 | 1,591.5 | 357,788 | 1,195.0 | 268,647 | 1,322.0 | 297,197 |
| | 1 1/2 | 816.3 | 1.2653 | 7.35 | 4.94 | 1,444.9 | 324,815 | 1,599.9 | 359,683 | 1,201.3 | 270,069 | 1,329.0 | 298,771 |
| 40 | | 900.8 | 1.3962 | 8.06 | 5.42 | 1,594.4 | 358,439 | 1,765.6 | 396,915 | 1,326.0 | 298,097 | 1,467.0 | 329,795 |
| | 1 5/8 | 959.1 | 1.4866 | 8.58 | 5.77 | 1,697.6 | 381,637 | 1,879.8 | 422,604 | 1,411.8 | 317,389 | 1,561.9 | 351,139 |
| 42 | | 992.5 | 1.5384 | 8.87 | 5.96 | 1,756.7 | 394,927 | 1,945.3 | 437,321 | 1,461.0 | 328,446 | 1,616.0 | 363,291 |
| 43 | | 1,040.3 | 1.6125 | 9.29 | 6.24 | 1,841.3 | 413,948 | 2,039.0 | 458,383 | 1,531.3 | 344,250 | 1,693.8 | 380,781 |
| 44 | | 1,087.1 | 1.6850 | 9.77 | 6.57 | 1,924.2 | 432,570 | 2,130.7 | 479,004 | 1,600.0 | 359,694 | 1,770.0 | 397,912 |
| | 1 3/4 | 1,109.4 | 1.7196 | 9.97 | 6.70 | 1,963.6 | 441,443 | 2,174.4 | 488,830 | 1,632.8 | 367,073 | 1,806.3 | 406,074 |
| 46 | | 1,188.0 | 1.8414 | 10.68 | 7.18 | 2,102.8 | 472,719 | 2,328.5 | 523,463 | 1,749.0 | 393,191 | 1,935.0 | 435,005 |
| 47 | | 1,240.3 | 1.9225 | 11.14 | 7.49 | 2,195.3 | 493,530 | 2,431.0 | 546,508 | 1,756.3 | 394,824 | 1,944.8 | 437,206 |
| | 1 7/8 | 1,273.4 | 1.9738 | 11.45 | 7.69 | 2,253.9 | 506,701 | 2,495.9 | 561,092 | 1,803.1 | 405,361 | 1,996.7 | 448,874 |
| 48 | | 1,298.8 | 2.0131 | 11.58 | 7.78 | 2,298.9 | 516,808 | 2,545.6 | 572,284 | 1,839.1 | 413,446 | 2,036.5 | 457,827 |
| 49 | | 1,353.5 | 2.0979 | 12.06 | 8.10 | 2,395.7 | 538,574 | 2,652.9 | 596,387 | 1,916.6 | 430,859 | 2,122.3 | 477,109 |
| 50 | | 1,410.7 | 2.1866 | 12.61 | 8.47 | 2,496.9 | 561,334 | 2,765.0 | 621,590 | 1,997.6 | 449,067 | 2,212.0 | 497,272 |
| | 2 | 1,456.2 | 2.2571 | 13.02 | 8.75 | 2,577.5 | 579,439 | 2,854.2 | 641,639 | 2,062.0 | 463,551 | 2,283.3 | 513,311 |
| 51 | | 1,467.6 | 2.2748 | 13.12 | 8.82 | 2,597.7 | 583,975 | 2,876.5 | 646,662 | 2,078.1 | 467,180 | 2,301.2 | 517,330 |
| 52 | | 1,526.3 | 2.3658 | 13.61 | 9.15 | 2,701.6 | 607,333 | 2,991.5 | 672,527 | 2,161.2 | 485,866 | 2,393.2 | 538,021 |
| 53 | | 1,585.5 | 2.4575 | 14.13 | 9.49 | 2,806.3 | 630,889 | 3,107.6 | 698,612 | 2,245.1 | 504,711 | 2,486.1 | 558,889 |
| 54 | 2 1/8 | 1,654.6 | 2.5646 | 14.70 | 9.88 | 2,928.6 | 658,385 | 3,243.0 | 729,059 | 2,342.9 | 526,708 | 2,594.4 | 583,247 |
| 55 | | 1,718.1 | 2.6631 | 15.26 | 10.25 | 3,041.0 | 683,652 | 3,367.5 | 757,039 | 2,432.8 | 546,922 | 2,694.0 | 605,631 |
| 56 | | 1,767.8 | 2.7401 | 15.81 | 10.62 | 3,129.0 | 703,428 | 3,464.9 | 778,938 | 2,503.2 | 562,743 | 2,771.9 | 623,150 |
| 57 | 2 1/4 | 1,831.5 | 2.8388 | 16.38 | 11.01 | 3,241.8 | 728,775 | 3,589.7 | 807,005 | 2,593.4 | 583,020 | 2,871.8 | 645,604 |
| 58 | | 1,896.3 | 2.9393 | 16.96 | 11.40 | 3,356.5 | 754,571 | 3,716.8 | 835,570 | 2,685.2 | 603,656 | 2,973.4 | 668,456 |
| 59 | | 1,962.3 | 3.0415 | 17.55 | 11.79 | 3,473.2 | 780,814 | 3,846.1 | 864,631 | 2,778.6 | 624,652 | 3,076.9 | 691,705 |
| 60 | | 2,029.4 | 3.1455 | 18.15 | 12.20 | 3,592.0 | 807,507 | 3,977.6 | 894,189 | 2,873.6 | 646,006 | 3,182.0 | 715,351 |
| | 2 3/8 | 2,051.5 | 3.1798 | 18.35 | 12.33 | 3,631.2 | 816,316 | 4,020.9 | 903,943 | 2,904.9 | 653,053 | 3,216.8 | 723,154 |
| 61 | | 2,097.7 | 3.2514 | 18.76 | 12.61 | 3,712.9 | 834,699 | 4,111.5 | 924,300 | 2,933.2 | 659,413 | 3,248.1 | 730,197 |
| 62 | | 2,167.1 | 3.3590 | 19.38 | 13.02 | 3,835.8 | 862,315 | 4,247.5 | 954,879 | 3,030.3 | 681,229 | 3,355.5 | 754,355 |
| 63 | | 2,237.5 | 3.4681 | 20.01 | 13.45 | 3,960.4 | 890,328 | 4,385.5 | 985,899 | 3,128.7 | 703,359 | 3,464.5 | 778,861 |
| | 2 ½ | 2,273.2 | 3.5235 | 20.33 | 13.66 | 4,023.6 | 904,533 | 4,455.5 | 1,001,630 | 3,178.6 | 714,581 | 3,519.8 | 791,288 |
| 64 | | 2,309.1 | 3.5791 | 20.65 | 13.88 | 4,087.1 | 918,818 | 4,525.8 | 1,017,448 | 3,228.8 | 725,866 | 3,575.4 | 803,784 |
| 65 | | 2,381.8 | 3.6918 | 21.30 | 14.31 | 4,215.8 | 947,746 | 4,668.3 | 1,049,482 | 3,330.5 | 748,720 | 3,688.0 | 829,091 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

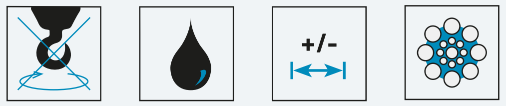
Special constructions and diameters available – please contact us directly.

# CASAR **VERSAPLAST M**

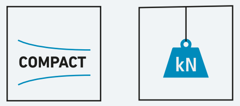


- Rotation resistant
- Fully lubricated
- Plastic layer between steel core and outer strands
- Extremely high breaking force
- Good resistance to drum crushing
- Available in ordinary (regular) lays or langs lay
- Available with plastic layer or without

## PROPERTIES



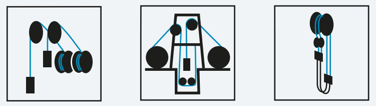

No swivel · Lubricated · Tolerance · Plast rope



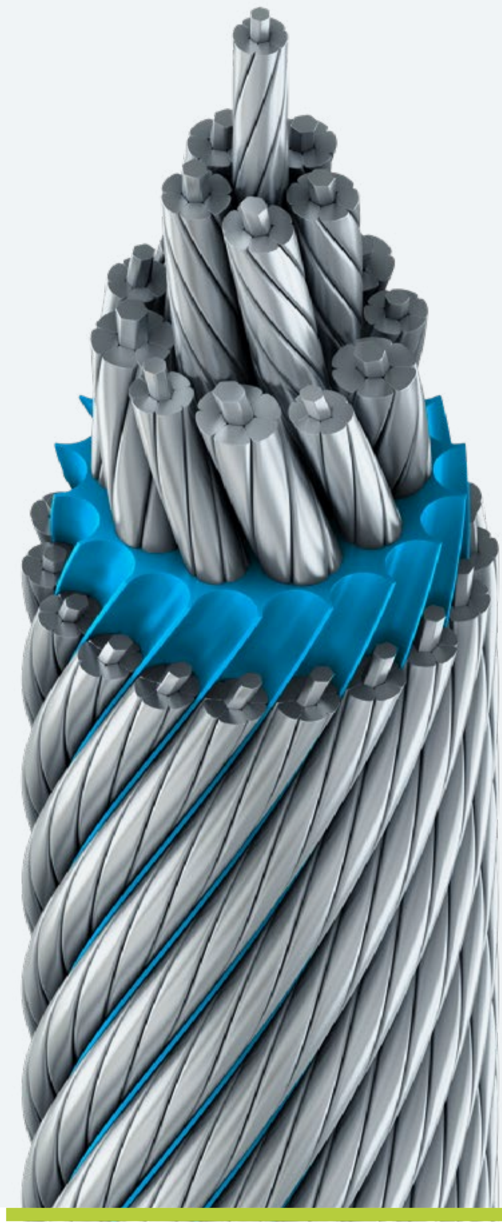

Compacted · High Breaking Force

## APPLICATIONS

Advanced hoist rope for drum, koepe friction winder and particularly shaft sinking applications, where rotation-resistant ropes are required. Rope design and manufacturing parameters are adjusted according to the application, i.e. Versaplast MD and Versaplast MF. The Versaplast M with compacted strands is a flexible rope that offers a high fatigue resistance as well as a good resistance to drum crushing.



Drum Winder · Shaft Sinking · Koepe Winder head rope



| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force 1770 N/mm² | | Aggregate Breaking Force 1960 N/mm² | | Minimum Breaking Force 1770 N/mm² | | Minimum Breaking Force 1960 N/mm² | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 224.1 | 0.3474 | 1.95 | 1.31 | 396.7 | 89,172 | 440.2 | 98,964 | 333.2 | 74,905 | 374.2 | 84,120 |
| 21 | | 246.6 | 0.3822 | 2.15 | 1.44 | 436.5 | 98,125 | 485.1 | 109,055 | 366.6 | 82,425 | 412.2 | 92,659 |
| 22 | | 270.5 | 0.4193 | 2.35 | 1.58 | 478.8 | 107,635 | 531.7 | 119,542 | 402.2 | 90,414 | 452.0 | 101,610 |
| | 7/8 | 274.1 | 0.4249 | 2.39 | 1.60 | 485.2 | 109,068 | 537.2 | 120,775 | 407.5 | 91,617 | 458.0 | 102,962 |
| 23 | | 296.2 | 0.4591 | 2.58 | 1.73 | 524.3 | 117,861 | 582.1 | 130,866 | 440.4 | 99,004 | 494.8 | 111,236 |
| 24 | | 323.0 | 0.5007 | 2.82 | 1.89 | 571.7 | 128,525 | 635.6 | 142,895 | 480.2 | 107,961 | 540.3 | 121,461 |
| 25 | | 351.0 | 0.5441 | 3.06 | 2.06 | 621.3 | 139,667 | 690.7 | 155,276 | 521.9 | 117,320 | 587.1 | 131,985 |
| | 1 | 356.4 | 0.5524 | 3.11 | 2.09 | 630.8 | 141,816 | 698.5 | 157,039 | 529.9 | 119,125 | 595.4 | 133,851 |
| 26 | | 377.0 | 0.5844 | 3.28 | 2.21 | 667.3 | 150,013 | 745.0 | 167,482 | 560.5 | 126,011 | 634.2 | 142,584 |
| 27 | | 409.0 | 0.6340 | 3.58 | 2.40 | 723.9 | 162,746 | 804.2 | 180,789 | 608.1 | 136,707 | 683.6 | 153,670 |
| 28 | | 439.6 | 0.6814 | 3.83 | 2.57 | 778.1 | 174,922 | 863.6 | 194,140 | 653.6 | 146,934 | 734.0 | 165,019 |
| | 1 1/8 | 458.4 | 0.7105 | 4.01 | 2.69 | 811.4 | 182,403 | 898.5 | 201,983 | 681.5 | 153,218 | 768.3 | 172,721 |
| 29 | | 470.1 | 0.7287 | 4.11 | 2.76 | 832.1 | 187,058 | 923.6 | 207,623 | 698.9 | 157,129 | 790.0 | 177,599 |
| 30 | | 505.6 | 0.7837 | 4.41 | 2.97 | 894.9 | 201,184 | 995.7 | 223,838 | 751.7 | 168,995 | 846.3 | 190,262 |
| | 1 1/4 | 560.1 | 0.8682 | 4.89 | 3.28 | 991.4 | 222,870 | 1,097.8 | 246,794 | 832.8 | 187,211 | 930.0 | 209,072 |
| 32 | | 571.6 | 0.8860 | 5.00 | 3.36 | 1,011.7 | 227,446 | 1,129.0 | 253,800 | 849.9 | 191,055 | 959.6 | 215,730 |
| 34 | | 644.1 | 0.9984 | 5.64 | 3.79 | 1,140.1 | 256,295 | 1,268.3 | 285,129 | 957.6 | 215,288 | 1,079.0 | 242,569 |
| | 1 3/8 | 685.7 | 1.0628 | 5.99 | 4.02 | 1,213.7 | 272,848 | 1,344.0 | 302,137 | 1,015.1 | 228,194 | 1,146.0 | 257,631 |
| 36 | | 731.2 | 1.1334 | 6.36 | 4.27 | 1,294.2 | 290,953 | 1,437.1 | 323,067 | 1,087.1 | 244,401 | 1,221.0 | 274,492 |
| 38 | 1 1/2 | 803.7 | 1.2457 | 7.03 | 4.73 | 1,422.5 | 319,802 | 1,589.0 | 357,215 | 1,194.9 | 268,633 | 1,352.0 | 303,942 |
| 40 | | 889.6 | 1.3789 | 7.77 | 5.22 | 1,574.6 | 353,982 | 1,756.2 | 394,800 | 1,322.7 | 297,345 | 1,495.0 | 336,094 |
| | 1 5/8 | 958.8 | 1.4861 | 8.38 | 5.63 | 1,697.1 | 381,518 | 1,879.2 | 422,472 | 1,418.4 | 318,874 | 1,602.0 | 360,144 |
| 42 | | 981.7 | 1.5216 | 8.57 | 5.76 | 1,737.6 | 390,630 | 1,935.5 | 435,118 | 1,459.6 | 328,129 | 1,645.0 | 369,811 |
| 44 | | 1,087.5 | 1.6856 | 9.47 | 6.36 | 1,924.9 | 432,729 | 2,131.5 | 479,180 | 1,623.0 | 364,857 | 1,818.0 | 408,703 |
| | 1 3/4 | 1,102.1 | 1.7082 | 9.61 | 6.46 | 1,950.6 | 438,523 | 2,160.0 | 485,596 | 1,638.5 | 368,359 | 1,838.0 | 413,199 |
| 46 | | 1,198.2 | 1.8572 | 10.43 | 7.01 | 2,120.8 | 476,778 | 2,347.9 | 527,825 | 1,781.5 | 400,493 | 1,995.0 | 448,494 |
| | 1 7/8 | 1,257.3 | 1.9488 | 10.96 | 7.37 | 2,225.4 | 500,294 | 2,464.3 | 553,998 | 1,869.4 | 420,247 | 2,095.0 | 470,975 |
| 48 | | 1,311.1 | 2.0322 | 11.43 | 7.68 | 2,320.6 | 521,702 | 2,569.8 | 577,704 | 1,949.3 | 438,230 | 2,184.0 | 490,983 |
| 50 | | 1,399.6 | 2.1694 | 12.15 | 8.17 | 2,477.3 | 556,917 | 2,743.2 | 616,699 | 2,080.9 | 467,811 | 2,331.0 | 524,030 |
| | 2 | 1,438.7 | 2.2300 | 12.54 | 8.43 | 2,546.5 | 572,476 | 2,819.9 | 633,928 | 2,139.1 | 480,880 | 2,400.0 | 539,541 |
| 52 | | 1,529.7 | 2.3710 | 13.30 | 8.94 | 2,707.6 | 608,686 | 2,998.2 | 674,025 | 2,274.4 | 511,296 | 2,548.0 | 572,813 |
| 54 | 2 1/8 | 1,662.3 | 2.5766 | 14.48 | 9.73 | 2,942.3 | 661,449 | 3,258.1 | 732,452 | 2,437.4 | 547,956 | 2,731.0 | 613,953 |
| 56 | | 1,771.0 | 2.7451 | 15.48 | 10.40 | 3,134.7 | 704,702 | 3,471.2 | 780,348 | 2,621.2 | 589,274 | 2,854.0 | 641,605 |
| | 2 1/4 | 1,854.8 | 2.8749 | 16.23 | 10.91 | 3,283.0 | 738,047 | 3,635.4 | 817,272 | 2,730.1 | 613,747 | 2,981.0 | 670,155 |
| 58 | | 1,906.0 | 2.9543 | 16.65 | 11.19 | 3,373.6 | 758,420 | 3,735.8 | 839,832 | 2,811.8 | 632,121 | 3,063.0 | 688,590 |
| 60 | | 2,055.0 | 3.1853 | 17.96 | 12.07 | 3,637.4 | 817,709 | 4,027.8 | 905,485 | 3,009.1 | 676,480 | 3,293.0 | 740,296 |
| | 2 3/8 | 2,053.0 | 3.1822 | 17.95 | 12.06 | 3,633.8 | 816,913 | 4,023.9 | 904,604 | 3,041.8 | 683,826 | 3,335.0 | 749,738 |
| 62 | | 2,163.9 | 3.3540 | 18.93 | 12.72 | 3,830.1 | 861,041 | 4,241.2 | 953,469 | 3,213.1 | 722,330 | 3,477.0 | 781,661 |
| | 2 1/2 | 2,272.4 | 3.5222 | 19.86 | 13.34 | 4,022.1 | 904,215 | 4,453.9 | 1,001,277 | 3,370.4 | 757,700 | 3,652.0 | 821,002 |
| 64 | | 2,334.0 | 3.6177 | 20.40 | 13.71 | 4,131.2 | 928,726 | 4,574.6 | 1,028,420 | 3,423.8 | 769,710 | 3,750.0 | 843,033 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

Special constructions and diameters available – please contact us directly.

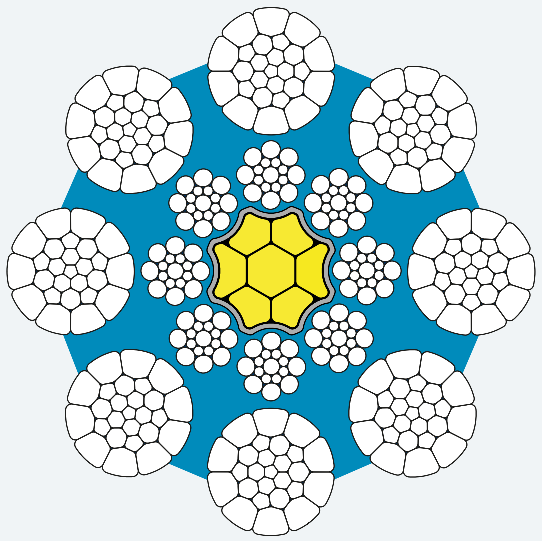
# SHARING KNOW-HOW ON HIGH-PERFORMANCE ROPES

Rope institutes, mines and Casar are working closely together to improve rope performance and service life. High-performance hoisting ropes from CASAR are understood by our customers worldwide as the most technically advanced solution. As a result, it is of great importance for us to present this technology and expertise to scientific learning and research at universities in the context of guest lectures. Our guest speakers regularly take part in various global events, including the annual "Mining and Oil Electromechanics" conference. This international conference is hosted by the Institute for Safety and Health and the Mining and Petroleum Faculty of the National Research Polytechnic University (PNRPU). In addition to the students from the city of Perm there is also a special audience from industry and mining from the entire CIS region and Eastern Europe.

In cooperation with the PNRPU, the regional rope center and the Russian mining company JSC Uralkali, the production capacity and service life of the CASAR hoisting ropes are also regularly discussed. Uralkali is the world leader in potash production for the international fertilizer market and has been operating a large number of hoisting machines for several mines and shafts with our CASAR high-performance hoisting ropes, mainly the CASAR Turboplast MD Ø63mm, for several years.

Our Turboplast MD is regularly measured with various products from our market competitors, which essentially correspond to the construction 8xK31WS. The comparisons are evaluated during and after operation by the Mining and Oil Faculty of the PNRPU, the regional rope center and Uralkali and presented at the annual "Mining and Oil Electromechanics" conference. Thanks to these extremely detailed investigations, it can be determined that the Turboplast MD shows, in addition to the unrivalled overall service life, a much more stable wear curve without accelerated or even sudden damage patterns. Such a level of performance offers the mine not only financial savings in operation, but also a special level of reliability and, above all, extraordinary operational safety. In addition, the company is making its contribution to sustainability and environmental protection by partially doubling the service life of the rope and thus reducing material consumption.

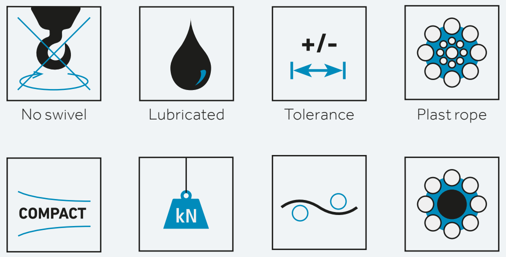
# CASAR **TURBOLITE M**



INNOVATIVE **DESIGN**

- New Innovation
- High performance mining rope
- Lightest hybrid mine hoist rope worldwide
- Best strength to weight ratio hoist rope on the market
- High strength fiber core for increased strength and resistance to bending fatigue
- Minimized stretch compared to other fiber core hoist ropes
- Plastic layer between core and outer strands
- Available in ordinary (regular) lay or langs lay

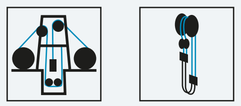
## PROPERTIES




No swivel, Lubricated, Tolerance, Plast rope, Compacted, High Breaking Force, preformed, Hybrid rope

## APPLICATIONS

Our latest innovation by Union, one of the two production families within WireCo WorldGroup. The steel and synthetic rope technology designed to our high performance hybrid rope CASAR Turbolite M. With the combination of steel and synthetic components, this innovative design offers a high breaking force, excellent fatigue as well as very good crushing and wear resistance. This makes our CASAR Turbolite M the future product for deep mining applications where the rope weight becomes a limitation factor for the hoisting capacity.



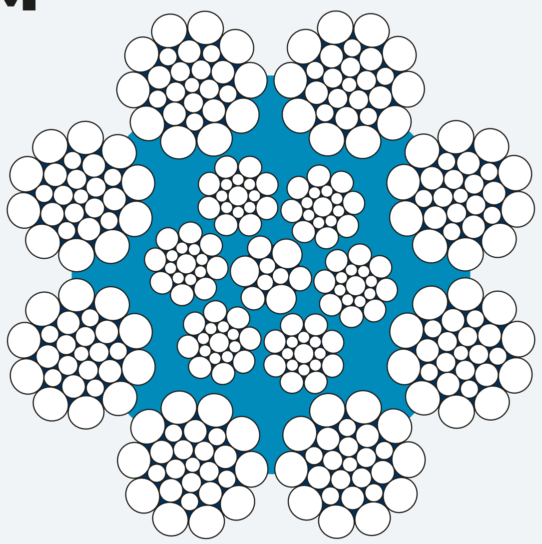
Shaft Sinking, Koepe Winder head rope

| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force 1770 N/mm² | | Aggregate Breaking Force 1960 N/mm² | | Minimum Breaking Force 1770 N/mm² | | Minimum Breaking Force 1960 N/mm² | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 191.8 | 0.2973 | 1.67 | 1.12 | 339.5 | 76,320 | 375.9 | 84,512 | 310.0 | 69,691 | 343.2 | 77,155 |
| 21 | | 211.4 | 0.3277 | 1.85 | 1.24 | 374.2 | 84,119 | 414.3 | 93,149 | 341.7 | 76,818 | 378.4 | 85,068 |
| 22 | | 232.0 | 0.3596 | 2.03 | 1.36 | 410.6 | 92,316 | 454.7 | 102,226 | 375.1 | 84,326 | 415.3 | 93,364 |
| 23 | | 253.6 | 0.3931 | 2.21 | 1.49 | 448.9 | 100,911 | 497.1 | 111,743 | 409.9 | 92,150 | 453.9 | 102,041 |
| 24 | | 276.1 | 0.4280 | 2.41 | 1.62 | 488.7 | 109,864 | 541.2 | 121,657 | 446.4 | 100,355 | 494.3 | 111,124 |
| 25 | | 299.6 | 0.4644 | 2.61 | 1.75 | 530.3 | 119,215 | 587.2 | 132,012 | 484.3 | 108,875 | 536.3 | 120,566 |
| 26 | | 324.1 | 0.5024 | 2.83 | 1.90 | 573.7 | 128,964 | 635.2 | 142,807 | 523.9 | 117,778 | 580.1 | 130,412 |
| 27 | | 349.5 | 0.5417 | 3.05 | 2.05 | 618.6 | 139,071 | 685.0 | 153,999 | 564.9 | 126,995 | 625.6 | 140,641 |
| 28 | | 375.8 | 0.5825 | 3.28 | 2.20 | 665.2 | 149,536 | 736.6 | 165,588 | 607.6 | 136,595 | 672.8 | 151,252 |
| 29 | | 403.2 | 0.6250 | 3.52 | 2.37 | 713.7 | 160,439 | 790.3 | 177,661 | 651.7 | 146,509 | 721.7 | 162,245 |
| 30 | | 431.4 | 0.6687 | 3.77 | 2.53 | 763.6 | 171,660 | 845.5 | 190,087 | 697.4 | 156,782 | 772.3 | 173,621 |
| 31 | | 460.7 | 0.7141 | 4.03 | 2.71 | 815.4 | 183,319 | 903.0 | 202,997 | 744.7 | 167,416 | 824.7 | 185,401 |
| 32 | | 490.9 | 0.7609 | 4.29 | 2.88 | 868.9 | 195,336 | 962.2 | 216,304 | 793.5 | 178,387 | 878.7 | 197,541 |
| 33 | | 522.0 | 0.8091 | 4.56 | 3.06 | 923.9 | 207,711 | 1,023.1 | 230,008 | 843.9 | 189,717 | 934.5 | 210,085 |
| 34 | | 554.2 | 0.8590 | 4.85 | 3.26 | 980.9 | 220,524 | 1,086.2 | 244,196 | 895.8 | 201,385 | 992.0 | 223,012 |
| 35 | | 587.2 | 0.9102 | 5.13 | 3.45 | 1,039.3 | 233,655 | 1,150.9 | 258,737 | 949.3 | 213,412 | 1,051.2 | 236,320 |
| 36 | | 621.3 | 0.9630 | 5.43 | 3.65 | 1,099.7 | 247,224 | 1,217.7 | 273,762 | 1,004.3 | 225,777 | 1,112.1 | 250,011 |
| 37 | | 656.3 | 1.0173 | 5.73 | 3.85 | 1,161.7 | 261,151 | 1,286.3 | 289,184 | 1,060.9 | 238,501 | 1,174.8 | 264,107 |
| 38 | | 692.2 | 1.0729 | 6.05 | 4.07 | 1,225.2 | 275,436 | 1,356.7 | 305,002 | 1,119.0 | 251,562 | 1,239.1 | 278,562 |
| 39 | | 729.1 | 1.1301 | 6.37 | 4.28 | 1,290.5 | 290,119 | 1,429.0 | 321,262 | 1,178.7 | 264,984 | 1,305.2 | 293,422 |
| 40 | | 767.0 | 1.1889 | 6.7 | 4.50 | 1,357.6 | 305,200 | 1,503.3 | 337,961 | 1,239.9 | 278,742 | 1,373.0 | 308,664 |
| 41 | | 805.8 | 1.2490 | 7.04 | 4.73 | 1,426.3 | 320,639 | 1,579.4 | 355,058 | 1,302.7 | 292,860 | 1,442.5 | 324,288 |
| 42 | | 845.6 | 1.3107 | 7.38 | 4.96 | 1,496.7 | 336,476 | 1,657.4 | 372,595 | 1,367.0 | 307,315 | 1,513.7 | 340,295 |
| 43 | | 886.4 | 1.3739 | 7.75 | 5.21 | 1,568.9 | 352,711 | 1,737.3 | 390,572 | 1,432.9 | 322,130 | 1,586.7 | 356,706 |
| 44 | | 928.1 | 1.4386 | 8.11 | 5.45 | 1,642.7 | 369,304 | 1,819.1 | 408,946 | 1,500.3 | 337,282 | 1,661.3 | 373,477 |
| 45 | | 970.7 | 1.5046 | 8.48 | 5.70 | 1,718.1 | 386,255 | 1,902.6 | 427,717 | 1,569.2 | 352,772 | 1,737.7 | 390,652 |
| 46 | | 1,014.4 | 1.5723 | 8.86 | 5.95 | 1,795.5 | 403,644 | 1,988.2 | 446,973 | 1,639.8 | 368,643 | 1,815.8 | 408,210 |
| 47 | | 1,058.9 | 1.6413 | 9.25 | 6.22 | 1,874.3 | 421,351 | 2,075.4 | 466,581 | 1,711.8 | 384,830 | 1,895.6 | 426,150 |
| 48 | | 1,104.5 | 1.7120 | 9.65 | 6.48 | 1,955.0 | 439,496 | 2,164.8 | 486,673 | 1,785.5 | 401,398 | 1,977.1 | 444,472 |
| 49 | | 1,151.0 | 1.7841 | 10.05 | 6.75 | 2,037.3 | 457,999 | 2,256.0 | 507,162 | 1,860.6 | 418,281 | 2,060.4 | 463,199 |
| 50 | | 1,198.4 | 1.8575 | 10.47 | 7.04 | 2,121.2 | 476,860 | 2,348.9 | 528,048 | 1,937.3 | 435,524 | 2,145.3 | 482,285 |
| 51 | | 1,246.9 | 1.9327 | 10.89 | 7.32 | 2,207.0 | 496,159 | 2,443.9 | 549,419 | 2,015.6 | 453,127 | 2,232.0 | 501,776 |
| 52 | | 1,296.2 | 2.0091 | 11.33 | 7.61 | 2,294.3 | 515,776 | 2,540.6 | 571,141 | 2,095.4 | 471,067 | 2,320.4 | 521,649 |
| 53 | | 1,346.6 | 2.0872 | 11.76 | 7.90 | 2,383.5 | 535,831 | 2,639.3 | 593,349 | 2,176.8 | 489,366 | 2,410.5 | 541,905 |
| 54 | | 1,397.9 | 2.1667 | 12.21 | 8.20 | 2,474.3 | 556,244 | 2,739.9 | 615,953 | 2,259.7 | 508,003 | 2,502.3 | 562,542 |
| 55 | | 1,450.1 | 2.2477 | 12.67 | 8.51 | 2,566.7 | 577,015 | 2,842.2 | 638,954 | 2,344.2 | 527,000 | 2,595.8 | 583,562 |
| 56 | | 1,503.3 | 2.3301 | 13.13 | 8.82 | 2,660.8 | 598,184 | 2,946.5 | 662,395 | 2,430.2 | 546,333 | 2,691.1 | 604,986 |
| 57 | | 1,557.5 | 2.4141 | 13.61 | 9.15 | 2,756.8 | 619,751 | 3,052.7 | 686,277 | 2,517.8 | 566,027 | 2,788.0 | 626,770 |
| 58 | | 1,612.6 | 2.4995 | 14.09 | 9.47 | 2,854.3 | 641,676 | 3,160.7 | 710,556 | 2,606.9 | 586,057 | 2,886.7 | 648,959 |
| 59 | | 1,668.7 | 2.5865 | 14.58 | 9.80 | 2,953.6 | 663,999 | 3,270.7 | 735,275 | 2,697.6 | 606,447 | 2,987.1 | 671,530 |
| 60 | | 1,725.8 | 2.6750 | 15.08 | 10.13 | 3,054.7 | 686,719 | 3,382.6 | 760,435 | 2,789.8 | 627,175 | 3,089.2 | 694,483 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

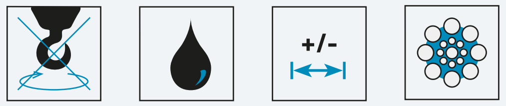
Special constructions and diameters available – please contact us directly.

# CASAR **STRATOPLAST M**

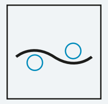


- High performance mining rope
- 8-strand construction made out of conventional strands
- Fully lubricated
- Plastic layer between steel core and outer strands
- High breaking force
- Very flexible
- Designed to have a specific unit weight
- Available in ordinary (regular) lay or langs lay

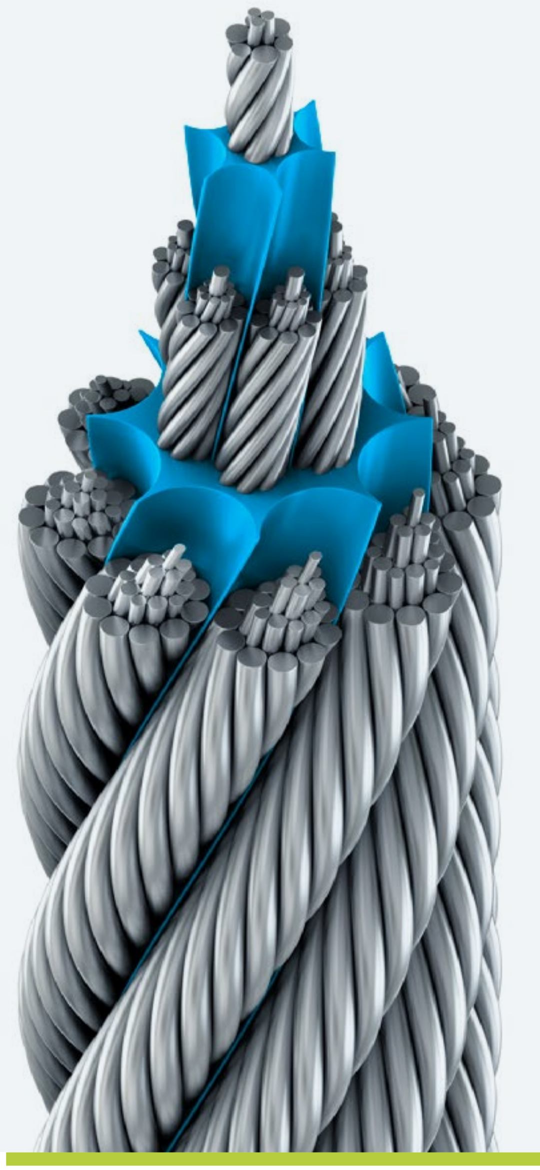
## PROPERTIES




No swivel | Lubricated | Tolerance | Plast rope

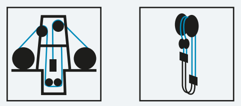


preformed



## APPLICATIONS

High performance hoist rope suitable for a wide range of applications. Rope design and manufacturing parameters are adjusted according to the application, i.e. Stratoplast MD and Stratoplast MF. The Stratoplast M with conventional strands offers a high breaking force with a moderate rope weight, which provides a special suitability for koepe friction winder head rope applications where ropes with compacted strands are too heavy. Less recommended for multi-layer drum winder applications.



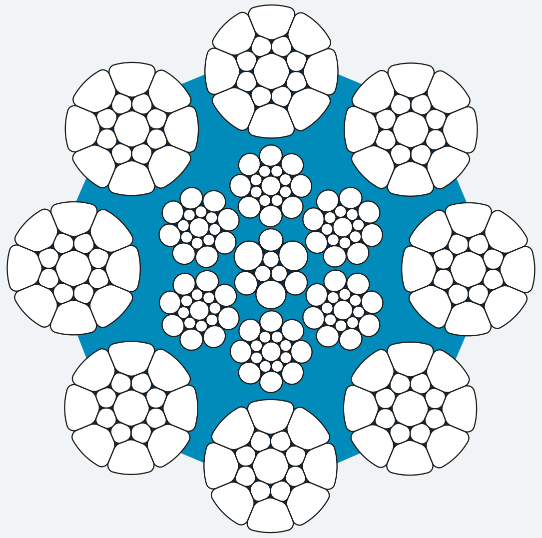
Shaft Sinking | Koepe Winder head rope

| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force 1770 N/mm² | | Aggregate Breaking Force 1960 N/mm² | | Minimum Breaking Force 1770 N/mm² | | Minimum Breaking Force 1960 N/mm² | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 191.0 | 0.2961 | 1.67 | 1.13 | 338.1 | 76,005 | 374.4 | 84,163 | 290.4 | 65,296 | 321.6 | 72,305 |
| 21 | | 210.6 | 0.3264 | 1.85 | 1.24 | 372.7 | 83,795 | 412.8 | 92,790 | 320.2 | 71,988 | 354.6 | 79,716 |
| 22 | | 231.1 | 0.3582 | 2.03 | 1.36 | 409.1 | 91,966 | 453.0 | 101,838 | 351.4 | 79,008 | 389.2 | 87,489 |
| | 7/8 | 235.9 | 0.3656 | 2.07 | 1.39 | 417.5 | 93,856 | 462.3 | 103,931 | 358.7 | 80,632 | 397.2 | 89,287 |
| 23 | | 252.6 | 0.3915 | 2.21 | 1.49 | 447.1 | 100,516 | 495.1 | 111,306 | 384.1 | 86,353 | 425.4 | 95,623 |
| 24 | | 275.1 | 0.4263 | 2.41 | 1.62 | 486.8 | 109,447 | 539.1 | 121,195 | 418.2 | 94,026 | 463.1 | 104,119 |
| 25 | | 298.5 | 0.4626 | 2.62 | 1.76 | 528.3 | 118,757 | 585.0 | 131,505 | 453.8 | 102,024 | 502.5 | 112,976 |
| | 1 | 308.1 | 0.4775 | 2.70 | 1.81 | 545.3 | 122,588 | 603.8 | 135,747 | 468.5 | 105,315 | 518.8 | 116,620 |
| 26 | | 322.8 | 0.5003 | 2.83 | 1.90 | 571.4 | 128,448 | 632.7 | 142,236 | 490.9 | 110,350 | 543.6 | 122,195 |
| 27 | | 348.1 | 0.5396 | 3.05 | 2.05 | 616.2 | 138,518 | 682.3 | 153,388 | 529.3 | 119,001 | 586.2 | 131,775 |
| 28 | | 374.4 | 0.5803 | 3.28 | 2.21 | 662.6 | 148,969 | 733.8 | 164,960 | 569.3 | 127,979 | 630.4 | 141,717 |
| | 1 1/8 | 389.9 | 0.6044 | 3.42 | 2.30 | 690.1 | 155,150 | 764.2 | 171,805 | 592.9 | 133,290 | 656.5 | 147,598 |
| 29 | | 401.6 | 0.6225 | 3.52 | 2.37 | 710.8 | 159,800 | 787.1 | 176,953 | 610.7 | 137,284 | 676.2 | 152,021 |
| 30 | | 429.8 | 0.6661 | 3.77 | 2.53 | 760.7 | 171,010 | 842.3 | 189,368 | 653.5 | 146,915 | 723.7 | 162,686 |
| 31 | | 458.9 | 0.7113 | 4.02 | 2.70 | 812.3 | 182,601 | 899.4 | 202,202 | 697.8 | 156,873 | 772.7 | 173,712 |
| | 1 1/4 | 481.4 | 0.7461 | 4.22 | 2.84 | 852.0 | 191,544 | 943.5 | 212,105 | 732.0 | 164,555 | 810.6 | 182,219 |
| 32 | | 489.0 | 0.7579 | 4.29 | 2.88 | 865.5 | 194,572 | 958.4 | 215,458 | 743.6 | 167,157 | 823.4 | 185,100 |
| 33 | | 520.0 | 0.8060 | 4.56 | 3.06 | 920.4 | 206,923 | 1,019.2 | 229,135 | 790.7 | 177,767 | 875.6 | 196,850 |
| 34 | | 552.0 | 0.8556 | 4.84 | 3.25 | 977.1 | 219,653 | 1,082.0 | 243,232 | 839.4 | 188,704 | 929.5 | 208,961 |
| | 1 3/8 | 582.5 | 0.9028 | 5.11 | 3.43 | 1,031.0 | 231,768 | 1,141.6 | 256,647 | 885.7 | 199,112 | 980.8 | 220,485 |
| 35 | | 585.0 | 0.9067 | 5.13 | 3.45 | 1,035.4 | 232,764 | 1,146.5 | 257,750 | 889.5 | 199,968 | 985.0 | 221,433 |
| 36 | | 618.9 | 0.9592 | 5.43 | 3.65 | 1,095.4 | 246,255 | 1,213.0 | 272,689 | 941.1 | 211,558 | 1,042.1 | 234,267 |
| 37 | | 653.7 | 1.0133 | 5.73 | 3.85 | 1,157.1 | 260,126 | 1,281.3 | 288,049 | 994.1 | 223,474 | 1,100.8 | 247,463 |
| 38 | | 689.5 | 1.0688 | 6.04 | 4.06 | 1,220.5 | 274,377 | 1,351.5 | 303,830 | 1,048.5 | 235,717 | 1,161.1 | 261,020 |
| | 1 1/2 | 693.2 | 1.0744 | 6.08 | 4.08 | 1,226.9 | 275,823 | 1,358.6 | 305,431 | 1,054.0 | 236,959 | 1,167.2 | 262,396 |
| 39 | | 726.3 | 1.1258 | 6.37 | 4.28 | 1,285.6 | 289,008 | 1,423.6 | 320,031 | 1,104.4 | 248,287 | 1,223.0 | 274,939 |
| 40 | | 764.0 | 1.1843 | 6.70 | 4.50 | 1,352.3 | 304,019 | 1,497.5 | 336,653 | 1,161.8 | 261,182 | 1,286.5 | 289,219 |
| 41 | | 802.7 | 1.2442 | 7.04 | 4.73 | 1,420.8 | 319,410 | 1,573.3 | 353,696 | 1,220.6 | 274,405 | 1,351.6 | 303,861 |
| | 1 5/8 | 813.5 | 1.2610 | 7.13 | 4.79 | 1,439.9 | 323,709 | 1,594.5 | 358,457 | 1,237.0 | 278,098 | 1,369.8 | 307,951 |
| 42 | | 842.3 | 1.3056 | 7.38 | 4.96 | 1,491.0 | 335,181 | 1,651.0 | 371,160 | 1,280.9 | 287,954 | 1,418.4 | 318,864 |
| 43 | | 882.9 | 1.3686 | 7.74 | 5.20 | 1,562.8 | 351,332 | 1,730.6 | 389,045 | 1,342.6 | 301,829 | 1,486.7 | 334,229 |
| 44 | | 924.5 | 1.4329 | 8.10 | 5.45 | 1,636.3 | 367,863 | 1,812.0 | 407,351 | 1,405.8 | 316,031 | 1,556.7 | 349,955 |
| | 1 3/4 | 943.5 | 1.4624 | 8.27 | 5.56 | 1,670.0 | 375,425 | 1,849.2 | 415,725 | 1,434.7 | 322,528 | 1,588.7 | 357,150 |
| 45 | | 967.0 | 1.4988 | 8.48 | 5.70 | 1,711.6 | 384,774 | 1,895.3 | 426,077 | 1,470.4 | 330,559 | 1,628.2 | 366,043 |
| 46 | | 1,010.4 | 1.5662 | 8.86 | 5.95 | 1,788.5 | 402,065 | 1,980.5 | 445,224 | 1,536.5 | 345,414 | 1,701.4 | 382,492 |
| 47 | | 1,054.8 | 1.6350 | 9.25 | 6.21 | 1,867.1 | 419,736 | 2,067.5 | 464,792 | 1,604.0 | 360,595 | 1,776.2 | 399,303 |
| | 1 7/8 | 1,083.1 | 1.6788 | 9.49 | 6.38 | 1,917.1 | 430,973 | 2,122.9 | 477,236 | 1,647.0 | 370,249 | 1,823.7 | 409,993 |
| 48 | | 1,100.2 | 1.7053 | 9.64 | 6.48 | 1,947.4 | 437,787 | 2,156.4 | 484,781 | 1,673.0 | 376,103 | 1,852.6 | 416,475 |
| 49 | | 1,146.5 | 1.7771 | 10.05 | 6.75 | 2,029.4 | 456,218 | 2,247.2 | 505,191 | 1,743.4 | 391,937 | 1,930.6 | 434,009 |
| 50 | | 1,193.8 | 1.8504 | 10.46 | 7.03 | 2,113.0 | 475,029 | 2,339.9 | 526,021 | 1,815.3 | 408,098 | 2,010.2 | 451,905 |
| | 2 | 1,232.3 | 1.9101 | 10.80 | 7.26 | 2,181.2 | 490,352 | 2,415.3 | 542,988 | 1,873.9 | 421,261 | 2,075.0 | 466,481 |
| 51 | | 1,242.0 | 1.9252 | 10.89 | 7.32 | 2,198.4 | 494,220 | 2,434.4 | 547,272 | 1,888.6 | 424,585 | 2,091.4 | 470,162 |
| 52 | | 1,291.2 | 2.0014 | 11.32 | 7.61 | 2,285.5 | 513,791 | 2,530.8 | 568,944 | 1,963.4 | 441,398 | 2,174.2 | 488,780 |
| 53 | | 1,341.4 | 2.0791 | 11.76 | 7.90 | 2,374.2 | 533,743 | 2,629.1 | 591,037 | 2,039.7 | 458,538 | 2,258.6 | 507,760 |
| 54 | 2 1/8 | 1,391.2 | 2.1563 | 12.19 | 8.19 | 2,462.4 | 553,561 | 2,726.7 | 612,983 | 2,115.4 | 475,564 | 2,342.5 | 526,614 |
| 55 | | 1,444.5 | 2.2390 | 12.66 | 8.51 | 2,556.8 | 574,785 | 2,831.2 | 636,485 | 2,196.5 | 493,798 | 2,432.3 | 546,805 |
| 56 | | 1,497.5 | 2.3211 | 13.13 | 8.82 | 2,650.6 | 595,877 | 2,935.1 | 659,841 | 2,277.1 | 511,918 | 2,521.6 | 566,869 |
| 57 | 2 1/4 | 1,559.6 | 2.4175 | 13.67 | 9.19 | 2,760.6 | 620,601 | 3,056.9 | 687,220 | 2,371.6 | 533,159 | 2,626.2 | 590,390 |
| 58 | | 1,606.4 | 2.4899 | 14.08 | 9.46 | 2,843.3 | 639,199 | 3,148.5 | 707,814 | 2,442.7 | 549,136 | 2,704.9 | 608,083 |
| 59 | | 1,662.3 | 2.5765 | 14.57 | 9.79 | 2,942.2 | 661,431 | 3,258.0 | 732,432 | 2,527.6 | 568,235 | 2,799.0 | 629,232 |
| 60 | | 1,719.1 | 2.6646 | 15.07 | 10.13 | 3,042.8 | 684,042 | 3,369.4 | 757,470 | 2,614.0 | 587,660 | 2,894.6 | 650,743 |
| | 2 3/8 | 1,737.8 | 2.6935 | 15.23 | 10.24 | 3,075.8 | 691,472 | 3,406.0 | 765,698 | 2,642.4 | 594,044 | 2,926.1 | 657,811 |
| 61 | | 1,776.9 | 2.7541 | 15.58 | 10.47 | 3,145.0 | 707,033 | 3,482.6 | 782,930 | 2,701.9 | 607,412 | 2,991.9 | 672,615 |
| 62 | | 1,835.6 | 2.8452 | 16.09 | 10.81 | 3,249.0 | 730,405 | 3,597.8 | 808,810 | 2,791.2 | 627,491 | 3,090.8 | 694,849 |
| 63 | | 1,895.3 | 2.9377 | 16.61 | 11.16 | 3,354.7 | 754,156 | 3,714.8 | 835,111 | 2,882.0 | 647,896 | 3,191.3 | 717,444 |
| | 2 1/2 | 1,925.5 | 2.9845 | 16.88 | 11.34 | 3,408.1 | 766,174 | 3,774.0 | 848,419 | 2,927.9 | 658,220 | 3,242.2 | 728,877 |
| 64 | | 1,955.9 | 3.0317 | 17.15 | 11.52 | 3,462.0 | 778,288 | 3,833.6 | 861,833 | 2,974.2 | 668,627 | 3,293.5 | 740,400 |
| 65 | | 2,017.5 | 3.1272 | 17.69 | 11.88 | 3,571.0 | 802,799 | 3,954.4 | 888,975 | 3,067.9 | 689,685 | 3,397.2 | 763,719 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

Special constructions and diameters available – please contact us directly.

# CASAR **DUROPLAST M**



- High performance mining rope
- 8-strand construction with compacted outer strands
- Fully lubricated
- Plastic layer between steel core and outer strands
- Very high breaking force
- Excellent resistance to abrasion
- Available in ordinary (regular) lay or langs lay

## PROPERTIES

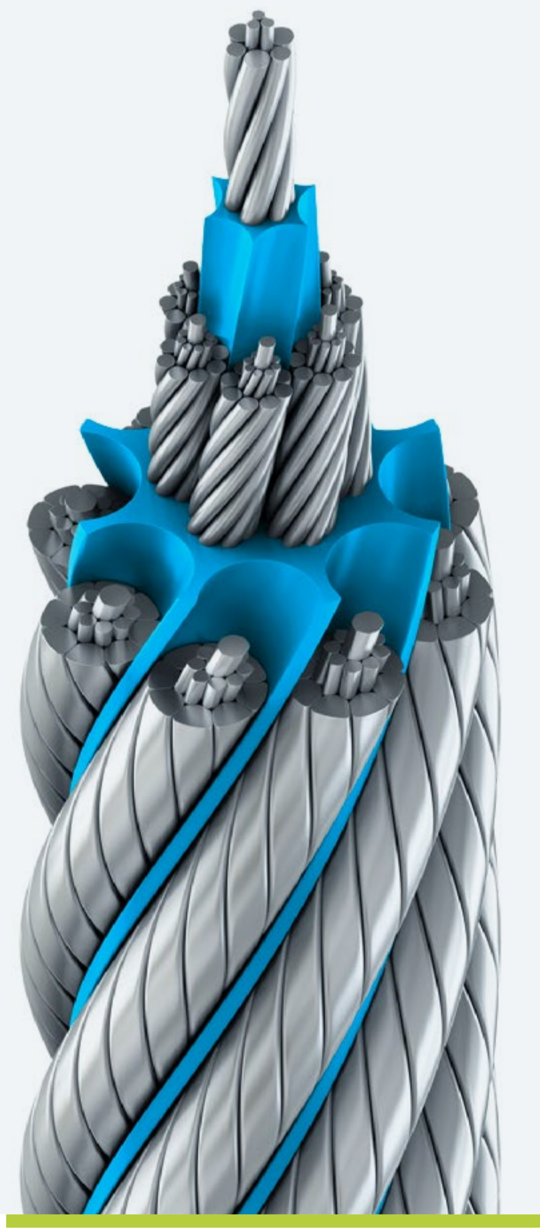
No swivel · Lubricated · Tolerance · Plast rope

Compacted · High Breaking Force · preformed

## APPLICATIONS

High performance hoist rope with a very high resistance against abrasion and drum crushing. Our CASAR Duroplast MD is particularly developed for heavy duty, multi-layer drum winder applications as well as incline haulage or conveyor drive applications. In addition, the compacted strands with maximized outer wire sizes offer an increased resistance against a corrosive environment.

Shaft Sinking · Koepe Winder head rope



| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force 1770 N/mm² | | Aggregate Breaking Force 1960 N/mm² | | Minimum Breaking Force 1770 N/mm² | | Minimum Breaking Force 1960 N/mm² | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 204.7 | 0.3173 | 1.78 | 1.20 | 362.3 | 81,453 | 401.2 | 90,196 | 303.3 | 68,192 | 335.9 | 75,512 |
| 21 | | 225.7 | 0.3498 | 1.96 | 1.32 | 399.5 | 89,809 | 442.4 | 99,449 | 334.5 | 75,188 | 370.4 | 83,259 |
| 22 | | 247.7 | 0.3839 | 2.16 | 1.45 | 438.4 | 98,563 | 485.5 | 109,143 | 367.1 | 82,517 | 406.5 | 91,374 |
| | 7/8 | 252.8 | 0.3918 | 2.20 | 1.48 | 447.4 | 100,589 | 495.5 | 111,387 | 374.6 | 84,213 | 414.8 | 93,253 |
| 23 | | 270.8 | 0.4197 | 2.36 | 1.59 | 479.3 | 107,755 | 530.8 | 119,321 | 401.3 | 90,212 | 444.4 | 99,896 |
| 24 | | 294.8 | 0.4569 | 2.56 | 1.72 | 521.8 | 117,304 | 577.8 | 129,896 | 436.8 | 98,207 | 483.7 | 108,749 |
| 25 | | 319.9 | 0.4958 | 2.78 | 1.87 | 566.2 | 127,292 | 627.0 | 140,956 | 474.0 | 106,569 | 524.9 | 118,008 |
| | 1 | 330.2 | 0.5118 | 2.87 | 1.93 | 584.5 | 131,398 | 647.2 | 145,503 | 489.3 | 110,006 | 541.9 | 121,815 |
| 26 | | 346.0 | 0.5363 | 3.01 | 2.02 | 612.4 | 137,677 | 678.2 | 152,456 | 512.7 | 115,264 | 567.8 | 127,637 |
| 27 | | 373.1 | 0.5783 | 3.25 | 2.18 | 660.4 | 148,461 | 731.3 | 164,397 | 552.9 | 124,291 | 612.2 | 137,633 |
| 28 | | 401.3 | 0.6220 | 3.49 | 2.35 | 710.3 | 159,682 | 786.5 | 176,823 | 594.7 | 133,686 | 658.5 | 148,036 |
| | 1 1/8 | 418.0 | 0.6478 | 3.63 | 2.44 | 739.8 | 166,308 | 819.2 | 184,160 | 619.3 | 139,233 | 685.8 | 154,179 |
| 29 | | 430.5 | 0.6673 | 3.75 | 2.52 | 762.0 | 171,301 | 843.8 | 189,689 | 637.9 | 143,413 | 706.4 | 158,808 |
| 30 | | 460.7 | 0.7141 | 4.01 | 2.69 | 815.4 | 183,318 | 903.0 | 202,996 | 682.7 | 153,474 | 756.0 | 169,948 |
| 31 | | 491.9 | 0.7624 | 4.28 | 2.88 | 870.7 | 195,733 | 964.1 | 216,744 | 728.9 | 163,867 | 807.2 | 181,458 |
| | 1 1/4 | 516.0 | 0.7998 | 4.49 | 3.02 | 913.3 | 205,318 | 1,011.3 | 227,358 | 764.6 | 171,892 | 846.7 | 190,344 |
| 32 | | 524.1 | 0.8124 | 4.56 | 3.06 | 927.7 | 208,546 | 1,027.2 | 230,932 | 776.6 | 174,594 | 860.0 | 193,336 |
| 33 | | 557.4 | 0.8640 | 4.85 | 3.26 | 986.6 | 221,796 | 1,092.5 | 245,605 | 826.0 | 185,688 | 914.6 | 205,620 |
| 34 | | 591.7 | 0.9171 | 5.15 | 3.46 | 1,047.3 | 235,444 | 1,159.7 | 260,718 | 876.8 | 197,114 | 970.9 | 218,273 |
| 35 | | 627.0 | 0.9719 | 5.46 | 3.67 | 1,109.8 | 249,491 | 1,228.9 | 276,272 | 929.1 | 208,874 | 1,028.9 | 231,295 |
| | 1 3/8 | 639.2 | 0.9907 | 5.57 | 3.74 | 1,131.3 | 254,325 | 1,252.7 | 281,626 | 947.1 | 212,921 | 1,048.8 | 235,777 |
| 36 | | 663.4 | 1.0283 | 5.77 | 3.88 | 1,174.2 | 263,975 | 1,300.3 | 292,311 | 983.1 | 221,000 | 1,088.6 | 244,723 |
| 37 | | 700.7 | 1.0861 | 6.10 | 4.10 | 1,240.2 | 278,817 | 1,373.4 | 308,746 | 1,038.3 | 233,425 | 1,149.8 | 258,482 |
| 38 | | 739.1 | 1.1456 | 6.43 | 4.32 | 1,308.2 | 294,097 | 1,448.6 | 325,666 | 1,095.2 | 246,218 | 1,212.8 | 272,648 |
| | 1 1/2 | 743.0 | 1.1516 | 6.46 | 4.34 | 1,315.1 | 295,646 | 1,456.3 | 327,383 | 1,101.0 | 247,515 | 1,219.2 | 274,085 |
| 39 | | 778.5 | 1.2067 | 6.77 | 4.55 | 1,377.9 | 309,774 | 1,525.9 | 343,027 | 1,153.6 | 259,343 | 1,277.4 | 287,182 |
| 40 | | 819.0 | 1.2695 | 7.12 | 4.78 | 1,449.6 | 325,890 | 1,605.2 | 360,872 | 1,213.6 | 272,835 | 1,343.9 | 302,122 |
| 41 | | 860.4 | 1.3336 | 7.49 | 5.03 | 1,522.9 | 342,363 | 1,686.4 | 379,114 | 1,275.0 | 286,627 | 1,411.8 | 317,394 |
| 42 | | 902.9 | 1.3995 | 7.86 | 5.28 | 1,598.1 | 359,275 | 1,769.7 | 397,841 | 1,338.0 | 300,785 | 1,481.6 | 333,072 |
| | 1 5/8 | 872.0 | 1.3516 | 7.59 | 5.10 | 1,543.4 | 346,978 | 1,709.1 | 384,224 | 1,292.2 | 290,490 | 1,430.9 | 321,673 |
| 43 | | 946.4 | 1.4669 | 8.23 | 5.53 | 1,675.1 | 376,584 | 1,854.9 | 417,008 | 1,402.4 | 315,276 | 1,553.0 | 349,119 |
| 44 | | 990.9 | 1.5359 | 8.62 | 5.79 | 1,753.9 | 394,291 | 1,942.2 | 436,616 | 1,468.4 | 330,100 | 1,626.0 | 365,535 |
| | 1 3/4 | 1,011.3 | 1.5675 | 8.80 | 5.91 | 1,790.0 | 402,397 | 1,982.1 | 445,592 | 1,498.5 | 336,887 | 1,659.4 | 373,050 |
| 45 | | 1,036.5 | 1.6066 | 9.02 | 6.06 | 1,834.6 | 412,436 | 2,031.5 | 456,708 | 1,535.9 | 345,291 | 1,700.8 | 382,356 |
| 46 | | 1,083.1 | 1.6788 | 9.42 | 6.33 | 1,917.1 | 430,978 | 2,122.9 | 477,241 | 1,605.0 | 360,815 | 1,777.3 | 399,547 |
| 47 | | 1,130.7 | 1.7526 | 9.84 | 6.61 | 2,001.3 | 449,919 | 2,216.2 | 498,215 | 1,675.5 | 376,672 | 1,855.4 | 417,106 |
| | 1 7/8 | 1,161.0 | 1.7995 | 10.10 | 6.79 | 2,054.9 | 461,964 | 2,275.5 | 511,554 | 1,720.4 | 386,757 | 1,905.1 | 428,273 |
| 48 | | 1,179.3 | 1.8279 | 10.26 | 6.89 | 2,087.4 | 469,257 | 2,311.4 | 519,630 | 1,747.5 | 392,862 | 1,935.1 | 435,034 |
| 49 | | 1,229.0 | 1.9050 | 10.69 | 7.18 | 2,175.3 | 489,034 | 2,408.8 | 541,529 | 1,821.2 | 409,419 | 2,016.7 | 453,368 |
| 50 | | 1,279.6 | 1.9834 | 11.13 | 7.48 | 2,264.9 | 509,168 | 2,508.0 | 563,824 | 1,896.2 | 426,275 | 2,099.7 | 472,034 |

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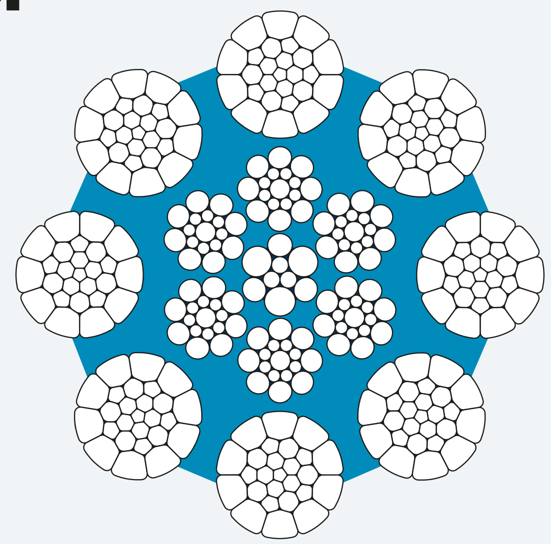
Special constructions and diameters available – please contact us directly.

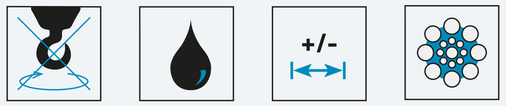
# CASAR **TURBOPLAST M**



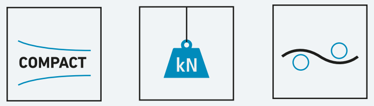
- High performance mining rope
- 8-strand construction with compacted outer strands
- Fully lubricated
- Plastic layer between steel core and outer strands
- Very high breaking force
- Good resistance to drum crushing
- Available in ordinary (regular) lay or langs lay

IMPROVED DESIGN

## PROPERTIES



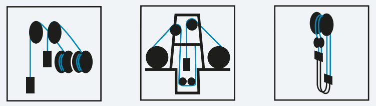
No swivel · Lubricated · Tolerance · Plast rope




Compacted · High Breaking Force · preformed

## APPLICATIONS

High performance hoist rope for a wide range of drum and koepe friction winder applications. Rope design and manufacturing parameters are adjusted according to the application, i.e. Turboplast MD and Turboplast MF. Our CASAR Turboplast M with compacted strands offers an excellent fatigue resistance as well as a good resistance to drum crushing.



Drum Winder · Shaft Sinking · Koepe Winder head rope



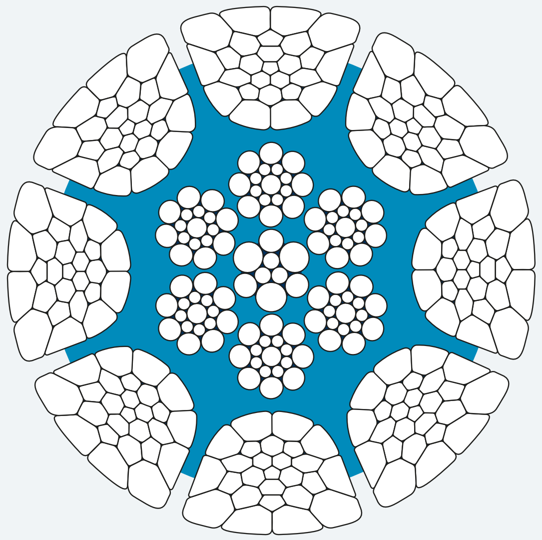
| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force 1770 N/mm² | | Aggregate Breaking Force 1960 N/mm² | | Minimum Breaking Force 1770 N/mm² | | Minimum Breaking Force 1960 N/mm² | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 207.0 | 0.3209 | 1.80 | 1.21 | 366.4 | 82,368 | 405.7 | 91,209 | 310.0 | 69,691 | 343.2 | 77,154 |
| 21 | | 228.3 | 0.3539 | 1.99 | 1.34 | 404.1 | 90,843 | 447.5 | 100,595 | 341.7 | 76,817 | 378.4 | 85,068 |
| 22 | | 250.5 | 0.3883 | 2.18 | 1.46 | 443.4 | 99,677 | 491.0 | 110,377 | 375.1 | 84,326 | 415.3 | 93,363 |
| | 7/8 | 255.6 | 0.3962 | 2.22 | 1.49 | 452.4 | 101,706 | 501.0 | 112,624 | 382.8 | 86,057 | 423.8 | 95,274 |
| 23 | | 273.8 | 0.4244 | 2.38 | 1.60 | 484.6 | 108,948 | 536.6 | 120,643 | 409.9 | 92,149 | 453.9 | 102,041 |
| 24 | | 298.1 | 0.4621 | 2.59 | 1.74 | 527.6 | 118,617 | 584.3 | 131,350 | 446.4 | 100,355 | 494.3 | 111,123 |
| 25 | | 323.5 | 0.5014 | 2.81 | 1.89 | 572.6 | 128,724 | 634.1 | 142,542 | 484.3 | 108,875 | 536.3 | 120,565 |
| | 1 | 333.9 | 0.5175 | 2.90 | 1.95 | 591.0 | 132,863 | 654.4 | 147,125 | 499.9 | 112,382 | 553.5 | 124,432 |
| 26 | | 349.9 | 0.5423 | 3.04 | 2.04 | 619.3 | 139,229 | 685.8 | 154,175 | 523.9 | 117,777 | 580.1 | 130,412 |
| 27 | | 377.3 | 0.5848 | 3.28 | 2.20 | 667.8 | 150,132 | 739.5 | 166,248 | 564.9 | 126,995 | 625.6 | 140,640 |
| 28 | | 405.8 | 0.6290 | 3.53 | 2.37 | 718.3 | 161,473 | 795.4 | 178,806 | 607.6 | 136,594 | 672.8 | 151,251 |
| | 1 1/8 | 422.6 | 0.6550 | 3.67 | 2.47 | 748.0 | 168,158 | 828.3 | 186,208 | 632.8 | 142,259 | 700.7 | 157,524 |
| 29 | | 435.3 | 0.6747 | 3.79 | 2.55 | 770.5 | 173,211 | 853.2 | 191,804 | 651.7 | 146,508 | 721.7 | 162,245 |
| 30 | | 465.8 | 0.7220 | 4.05 | 2.72 | 824.5 | 185,347 | 913.0 | 205,243 | 697.4 | 156,782 | 772.3 | 173,620 |
| 31 | | 497.4 | 0.7710 | 4.33 | 2.91 | 880.4 | 197,921 | 974.9 | 219,167 | 744.7 | 167,415 | 824.7 | 185,400 |
| | 1 1/4 | 521.7 | 0.8086 | 4.54 | 3.05 | 923.4 | 207,591 | 1,022.5 | 229,874 | 781.1 | 175,598 | 865.0 | 194,460 |
| 32 | | 530.0 | 0.8215 | 4.61 | 3.10 | 938.1 | 210,893 | 1,038.8 | 233,531 | 793.5 | 178,386 | 878.7 | 197,540 |
| 33 | | 563.7 | 0.8737 | 4.90 | 3.29 | 997.7 | 224,303 | 1,104.9 | 248,381 | 843.9 | 189,716 | 934.5 | 210,084 |
| 34 | | 598.3 | 0.9274 | 5.21 | 3.50 | 1,059.0 | 238,071 | 1,172.7 | 263,626 | 895.8 | 201,384 | 992.0 | 223,010 |
| | 1 3/8 | 631.2 | 0.9784 | 5.49 | 3.69 | 1,117.2 | 251,162 | 1,237.2 | 278,123 | 945.2 | 212,489 | 1,046.7 | 235,307 |
| 35 | | 634.1 | 0.9829 | 5.52 | 3.71 | 1,122.4 | 252,316 | 1,242.8 | 279,401 | 949.3 | 213,411 | 1,051.2 | 236,319 |
| 36 | | 670.5 | 1.0393 | 5.84 | 3.92 | 1,186.8 | 266,800 | 1,314.2 | 295,439 | 1,004.3 | 225,776 | 1,112.1 | 250,010 |
| 37 | | 708.6 | 1.0983 | 6.16 | 4.14 | 1,254.2 | 281,960 | 1,388.9 | 312,227 | 1,060.9 | 238,500 | 1,174.8 | 264,105 |
| 38 | | 747.4 | 1.1585 | 6.50 | 4.37 | 1,322.9 | 297,399 | 1,464.9 | 329,323 | 1,119.0 | 251,561 | 1,239.1 | 278,561 |
| | 1 1/2 | 751.3 | 1.1645 | 6.53 | 4.39 | 1,329.8 | 298,951 | 1,472.5 | 331,042 | 1,124.8 | 252,865 | 1,245.6 | 280,022 |
| 39 | | 787.3 | 1.2203 | 6.85 | 4.60 | 1,393.5 | 313,276 | 1,543.1 | 346,904 | 1,178.7 | 264,982 | 1,305.2 | 293,421 |
| 40 | | 828.1 | 1.2836 | 7.20 | 4.84 | 1,465.7 | 329,511 | 1,623.1 | 364,882 | 1,239.9 | 278,741 | 1,373.0 | 308,663 |
| 41 | | 870.1 | 1.3487 | 7.57 | 5.09 | 1,540.1 | 346,223 | 1,705.4 | 383,388 | 1,302.7 | 292,859 | 1,442.5 | 324,287 |
| | 1 5/8 | 881.8 | 1.3668 | 7.67 | 5.15 | 1,560.8 | 350,879 | 1,728.3 | 388,544 | 1,320.2 | 296,793 | 1,461.9 | 328,648 |
| 42 | | 913.0 | 1.4152 | 7.94 | 5.34 | 1,616.0 | 363,293 | 1,789.5 | 402,291 | 1,367.0 | 307,314 | 1,513.7 | 340,293 |
| 43 | | 957.0 | 1.4834 | 8.33 | 5.60 | 1,693.9 | 380,802 | 1,875.7 | 421,679 | 1,432.9 | 322,129 | 1,586.7 | 356,704 |
| 44 | | 1,002.1 | 1.5533 | 8.72 | 5.86 | 1,773.7 | 398,747 | 1,964.1 | 441,551 | 1,500.3 | 337,281 | 1,661.3 | 373,475 |
| | 1 3/4 | 1,022.7 | 1.5852 | 8.89 | 5.97 | 1,810.2 | 406,944 | 2,004.5 | 450,628 | 1,531.1 | 344,205 | 1,695.4 | 381,141 |
| 45 | | 1,048.1 | 1.6246 | 9.12 | 6.13 | 1,855.1 | 417,051 | 2,054.3 | 461,820 | 1,569.2 | 352,770 | 1,737.7 | 390,650 |
| 46 | | 1,095.2 | 1.6976 | 9.53 | 6.40 | 1,938.5 | 435,793 | 2,146.6 | 482,573 | 1,639.8 | 368,642 | 1,815.8 | 408,208 |
| 47 | | 1,143.4 | 1.7723 | 9.95 | 6.69 | 2,023.8 | 454,972 | 2,241.1 | 503,811 | 1,711.8 | 384,828 | 1,895.6 | 426,148 |
| | 1 7/8 | 1,174.0 | 1.8197 | 10.21 | 6.86 | 2,078.0 | 467,148 | 2,301.0 | 517,294 | 1,757.6 | 395,124 | 1,946.3 | 437,546 |
| 48 | | 1,192.5 | 1.8484 | 10.38 | 6.98 | 2,110.7 | 474,510 | 2,337.3 | 525,446 | 1,785.5 | 401,396 | 1,977.1 | 444,470 |
| 49 | | 1,242.7 | 1.9262 | 10.81 | 7.26 | 2,199.6 | 494,485 | 2,435.7 | 547,565 | 1,860.6 | 418,279 | 2,060.4 | 463,196 |
| 50 | | 1,303.7 | 2.0208 | 11.26 | 7.57 | 2,307.6 | 518,762 | 2,555.3 | 574,448 | 1,937.3 | 435,522 | 2,145.3 | 482,283 |
| | 2 | 1,345.7 | 2.0858 | 11.62 | 7.81 | 2,381.9 | 535,470 | 2,637.6 | 592,950 | 1,999.7 | 449,550 | 2,214.4 | 497,817 |
| 51 | | 1,346.3 | 2.0868 | 11.71 | 7.87 | 2,383.0 | 535,709 | 2,638.7 | 593,214 | 2,015.6 | 453,125 | 2,232.0 | 501,773 |
| 52 | | 1,399.6 | 2.1694 | 12.18 | 8.18 | 2,477.3 | 556,917 | 2,743.2 | 616,699 | 2,095.4 | 471,065 | 2,320.4 | 521,647 |
| 53 | | 1,453.9 | 2.2535 | 12.65 | 8.50 | 2,573.4 | 578,524 | 2,849.6 | 640,625 | 2,176.8 | 489,364 | 2,410.5 | 541,902 |
| | 2 1/8 | 1,507.8 | 2.3371 | 13.11 | 8.81 | 2,668.8 | 599,971 | 2,955.3 | 664,375 | 2,257.6 | 507,529 | 2,500.0 | 562,022 |
| 54 | | 1,509.3 | 2.3394 | 13.13 | 8.82 | 2,671.5 | 600,568 | 2,958.2 | 665,036 | 2,259.7 | 508,001 | 2,502.3 | 562,539 |
| 55 | | 1,565.7 | 2.4268 | 13.62 | 9.15 | 2,771.3 | 623,010 | 3,068.8 | 689,887 | 2,344.2 | 526,997 | 2,595.8 | 583,559 |
| 56 | | 1,623.2 | 2.5160 | 14.12 | 9.49 | 2,873.1 | 645,890 | 3,181.5 | 715,223 | 2,430.2 | 546,331 | 2,691.1 | 604,983 |
| 57 | | 1,681.7 | 2.6066 | 14.63 | 9.83 | 2,976.6 | 669,168 | 3,296.1 | 741,000 | 2,517.8 | 566,024 | 2,788.0 | 626,767 |
| | 2 1/4 | 1,690.5 | 2.6203 | 14.70 | 9.88 | 2,992.2 | 672,670 | 3,313.4 | 744,877 | 2,531.0 | 568,991 | 2,802.6 | 630,049 |
| 58 | | 1,741.2 | 2.6989 | 15.15 | 10.18 | 3,081.9 | 692,844 | 3,412.8 | 767,217 | 2,606.9 | 586,054 | 2,886.7 | 648,956 |
| 59 | | 1,801.7 | 2.7926 | 15.68 | 10.54 | 3,189.0 | 716,918 | 3,531.3 | 793,875 | 2,697.6 | 606,444 | 2,987.1 | 671,527 |
| 60 | | 1,863.3 | 2.8881 | 16.21 | 10.89 | 3,298.0 | 741,429 | 3,652.1 | 821,017 | 2,789.8 | 627,172 | 3,089.2 | 694,480 |
| | 2 3/8 | 1,883.5 | 2.9194 | 16.39 | 11.01 | 3,333.8 | 749,467 | 3,691.7 | 829,918 | 2,820.1 | 633,984 | 3,122.8 | 702,033 |
| 61 | | 1,925.9 | 2.9851 | 16.75 | 11.26 | 3,408.8 | 766,338 | 3,774.8 | 848,601 | 2,883.6 | 648,259 | 3,193.0 | 717,815 |
| 62 | | 1,989.6 | 3.0839 | 17.31 | 11.63 | 3,521.6 | 791,685 | 3,899.6 | 876,668 | 2,978.9 | 669,683 | 3,298.6 | 741,555 |
| 63 | | 2,054.3 | 3.1842 | 17.87 | 12.01 | 3,636.1 | 817,430 | 4,026.4 | 905,177 | 3,075.8 | 691,467 | 3,405.8 | 765,654 |
| | 2 ½ | 2,087.0 | 3.2349 | 18.16 | 12.20 | 3,694.0 | 830,442 | 4,090.5 | 919,585 | 3,124.8 | 702,483 | 3,460.1 | 777,861 |
| 64 | | 2,120.0 | 3.2860 | 18.44 | 12.39 | 3,752.4 | 843,573 | 4,155.2 | 934,126 | 3,174.2 | 713,588 | 3,514.8 | 790,158 |
| 65 | | 2,186.8 | 3.3895 | 19.02 | 12.78 | 3,870.6 | 870,153 | 4,286.1 | 963,560 | 3,274.1 | 736,047 | 3,625.5 | 815,045 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

Special constructions and diameters available – please contact us directly.

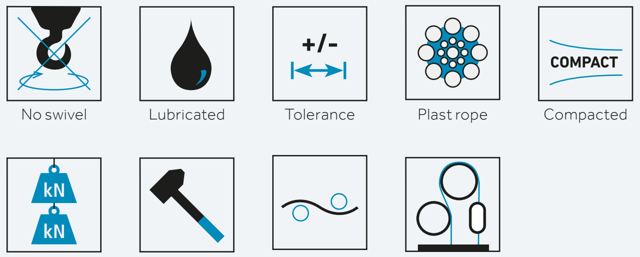
# CASAR **TURBOFIT M**

- High performance mining rope
- Swaged 8-strand construction with compacted outer strands
- Fully lubricated
- Plastic layer between steel core and outer strands
- Very High breaking force
- Excellent resistance to drum crushing
- Available in ordinary (regular) lay or langs lay



INNOVATIVE DESIGN

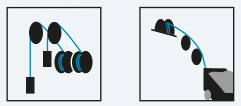
## PROPERTIES



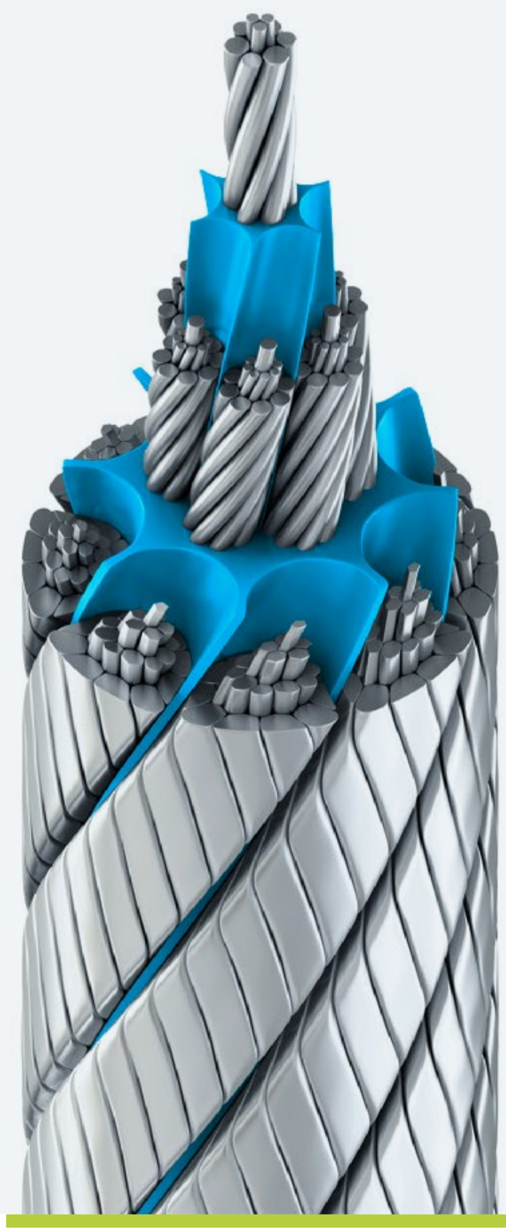

No swivel
Lubricated
Tolerance
Plast rope
Compacted
**VERY** High Breaking Force
Swaged
preformed
Ultra Deep

## APPLICATIONS

High performance hoist rope particularly developed for heavy duty, multi-layer drum winder applications. Our CASAR Turbofit MD is cold swaged after manufacture which makes it a very durable rope design to provide an increased surface contact area and provides a maximum resistance against abrasion and crushing.
Less recommended for koepe friction winder applications.



Drum Winder
Slope Winder



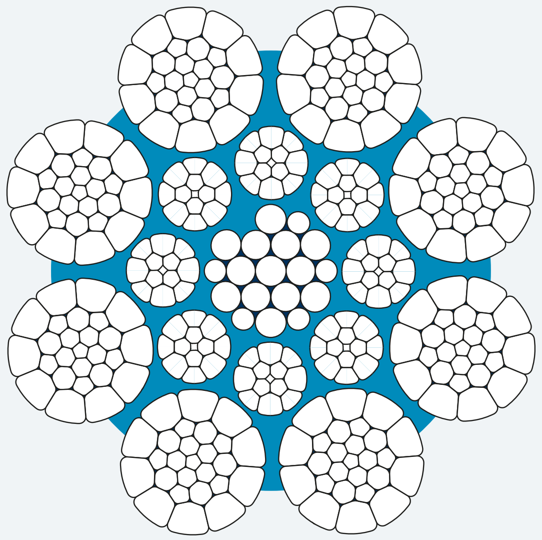


| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force | | | | Minimum Breaking Force | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1770 N/mm² | | 1960 N/mm² | | 1770 N/mm² | | 1960 N/mm² | |
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 222.4 | 0.3447 | 1.93 | 1.30 | 393.6 | 88,496 | 435.9 | 97,995 | 338.5 | 76,098 | 374.8 | 84,258 |
| 21 | | 245.2 | 0.3801 | 2.13 | 1.43 | 434.0 | 97,568 | 480.6 | 108,041 | 373.2 | 83,899 | 413.2 | 92,891 |
| 22 | | 269.1 | 0.4171 | 2.34 | 1.57 | 476.3 | 107,078 | 527.4 | 118,572 | 409.6 | 92,082 | 453.5 | 101,951 |
| | 7/8 | 274.6 | 0.4256 | 2.39 | 1.61 | 486.1 | 109,279 | 538.3 | 121,010 | 418.0 | 93,975 | 462.8 | 104,047 |
| 23 | | 294.1 | 0.4559 | 2.56 | 1.72 | 520.6 | 117,026 | 576.4 | 129,588 | 447.6 | 100,624 | 495.7 | 111,438 |
| 24 | | 320.2 | 0.4963 | 2.79 | 1.87 | 566.8 | 127,411 | 627.6 | 141,088 | 487.4 | 109,572 | 539.7 | 121,329 |
| 25 | | 347.4 | 0.5385 | 3.02 | 2.03 | 614.9 | 138,235 | 680.9 | 153,073 | 528.9 | 118,901 | 585.6 | 131,648 |
| | 1 | 358.6 | 0.5558 | 3.12 | 2.10 | 634.7 | 142,693 | 702.9 | 158,011 | 546.0 | 122,737 | 604.5 | 135,895 |
| 26 | | 375.8 | 0.5825 | 3.27 | 2.20 | 665.2 | 149,535 | 736.6 | 165,587 | 572.0 | 128,591 | 633.4 | 142,394 |
| 27 | | 405.3 | 0.6282 | 3.53 | 2.37 | 717.4 | 161,274 | 794.4 | 178,585 | 616.9 | 138,685 | 683.1 | 153,567 |
| 28 | | 435.8 | 0.6755 | 3.79 | 2.55 | 771.4 | 173,410 | 854.2 | 192,025 | 663.4 | 149,138 | 734.6 | 165,145 |
| | 1 1/8 | 453.9 | 0.7035 | 3.95 | 2.65 | 803.4 | 180,605 | 889.6 | 199,992 | 690.9 | 155,326 | 765.1 | 171,997 |
| 29 | | 467.5 | 0.7246 | 4.07 | 2.73 | 827.5 | 186,024 | 916.3 | 205,992 | 711.7 | 159,996 | 788.0 | 177,149 |
| 30 | | 500.3 | 0.7755 | 4.35 | 2.92 | 885.5 | 199,075 | 980.6 | 220,445 | 761.6 | 171,214 | 843.3 | 189,581 |
| 31 | | 534.2 | 0.8280 | 4.65 | 3.12 | 945.5 | 212,564 | 1,047.0 | 235,382 | 813.2 | 182,815 | 900.5 | 202,440 |
| | 1 1/4 | 560.4 | 0.8686 | 4.88 | 3.28 | 991.8 | 222,974 | 1,098.3 | 246,909 | 853.0 | 191,767 | 944.6 | 212,354 |
| 32 | | 569.2 | 0.8823 | 4.95 | 3.33 | 1,007.5 | 226,491 | 1,115.6 | 250,804 | 866.5 | 194,797 | 959.5 | 215,704 |
| 33 | | 605.4 | 0.9384 | 5.27 | 3.54 | 1,071.6 | 240,896 | 1,186.6 | 266,755 | 921.5 | 207,161 | 1,020.4 | 229,395 |
| 34 | | 642.6 | 0.9960 | 5.59 | 3.76 | 1,137.4 | 255,698 | 1,259.5 | 283,146 | 978.2 | 219,908 | 1,083.2 | 243,513 |
| 35 | 1 3/8 | 681.0 | 1.0556 | 5.92 | 3.98 | 1,205.4 | 270,978 | 1,334.8 | 300,066 | 1,036.6 | 233,037 | 1,147.9 | 258,058 |
| 36 | | 720.5 | 1.1168 | 6.27 | 4.21 | 1,275.3 | 286,695 | 1,412.2 | 317,471 | 1,096.7 | 246,548 | 1,214.4 | 273,008 |
| 37 | | 761.0 | 1.1796 | 6.62 | 4.45 | 1,347.0 | 302,811 | 1,491.6 | 335,316 | 1,158.4 | 260,419 | 1,282.8 | 288,385 |
| 38 | | 802.7 | 1.2442 | 6.98 | 4.69 | 1,420.8 | 319,404 | 1,573.3 | 353,690 | 1,221.9 | 274,694 | 1,353.1 | 304,189 |
| 39 | 1 1/2 | 845.5 | 1.3105 | 7.36 | 4.94 | 1,496.5 | 336,434 | 1,657.2 | 372,549 | 1,287.1 | 289,352 | 1,425.2 | 320,398 |
| 40 | | 889.4 | 1.3786 | 7.74 | 5.20 | 1,574.2 | 353,903 | 1,743.2 | 391,892 | 1,353.9 | 304,369 | 1,499.3 | 337,056 |
| 41 | 1 5/8 | 934.5 | 1.4485 | 8.13 | 5.46 | 1,654.1 | 371,849 | 1,831.6 | 411,764 | 1,422.5 | 319,791 | 1,575.2 | 354,119 |
| 42 | | 980.6 | 1.5199 | 8.53 | 5.73 | 1,735.7 | 390,192 | 1,922.0 | 432,077 | 1,492.7 | 335,572 | 1,652.9 | 371,587 |
| 43 | | 1,027.9 | 1.5932 | 8.94 | 6.01 | 1,819.4 | 409,013 | 2,014.7 | 452,919 | 1,564.6 | 351,736 | 1,732.6 | 389,504 |
| 44 | | 1,076.2 | 1.6681 | 9.36 | 6.29 | 1,904.9 | 428,233 | 2,109.4 | 474,201 | 1,638.2 | 368,282 | 1,814.1 | 407,826 |
| | 1 3/4 | 1,098.3 | 1.7024 | 9.56 | 6.42 | 1,944.0 | 437,037 | 2,152.7 | 483,950 | 1,671.9 | 375,854 | 1,851.4 | 416,210 |
| 45 | | 1,125.7 | 1.7448 | 9.79 | 6.58 | 1,992.5 | 447,929 | 2,206.4 | 496,012 | 1,713.6 | 385,233 | 1,897.5 | 426,575 |
| 46 | | 1,176.3 | 1.8233 | 10.23 | 6.88 | 2,082.1 | 468,064 | 2,305.5 | 518,308 | 1,790.6 | 402,543 | 1,982.8 | 445,751 |
| 47 | | 1,228.0 | 1.9034 | 10.68 | 7.18 | 2,173.6 | 488,636 | 2,406.9 | 541,088 | 1,869.3 | 420,235 | 2,069.9 | 465,332 |
| | 1 7/8 | 1,260.9 | 1.9544 | 10.97 | 7.37 | 2,231.8 | 501,718 | 2,471.3 | 555,574 | 1,919.3 | 431,486 | 2,125.3 | 477,790 |
| 48 | | 1,280.8 | 1.9852 | 11.14 | 7.49 | 2,267.0 | 509,645 | 2,510.4 | 564,353 | 1,949.6 | 438,287 | 2,158.9 | 485,340 |
| 49 | | 1,334.7 | 2.0688 | 11.61 | 7.80 | 2,362.4 | 531,093 | 2,616.0 | 588,103 | 2,031.7 | 456,744 | 2,249.8 | 505,775 |
| 50 | | 1,389.8 | 2.1542 | 12.09 | 8.12 | 2,459.9 | 553,018 | 2,724.0 | 612,381 | 2,115.5 | 475,583 | 2,342.6 | 526,637 |
| | 2 | 1,434.6 | 2.2236 | 12.48 | 8.39 | 2,539.3 | 570,856 | 2,811.9 | 632,134 | 2,183.7 | 490,924 | 2,418.2 | 543,625 |
| 51 | | 1,445.9 | 2.2411 | 12.58 | 8.45 | 2,559.2 | 575,341 | 2,834.0 | 637,100 | 2,201.0 | 494,804 | 2,437.2 | 547,904 |
| 52 | | 1,503.2 | 2.3300 | 13.08 | 8.79 | 2,660.7 | 598,141 | 2,946.3 | 662,348 | 2,288.1 | 514,385 | 2,533.7 | 569,598 |
| 53 | | 1,561.5 | 2.4203 | 13.59 | 9.13 | 2,763.9 | 621,339 | 3,060.5 | 688,037 | 2,377.0 | 534,371 | 2,632.1 | 591,720 |
| 54 | 2 1/8 | 1,621.0 | 2.5126 | 14.10 | 9.48 | 2,869.2 | 645,015 | 3,177.2 | 714,254 | 2,467.5 | 554,716 | 2,732.4 | 614,268 |
| 55 | | 1,681.6 | 2.6065 | 14.63 | 9.83 | 2,976.4 | 669,128 | 3,295.9 | 740,956 | 2,559.7 | 575,443 | 2,834.5 | 637,221 |
| 56 | | 1,743.3 | 2.7021 | 15.17 | 10.19 | 3,085.6 | 693,680 | 3,416.9 | 768,142 | 2,653.7 | 596,575 | 2,938.5 | 660,601 |
| 57 | 2 1/4 | 1,806.1 | 2.7995 | 15.71 | 10.56 | 3,196.8 | 718,668 | 3,540.0 | 795,814 | 2,749.3 | 618,067 | 3,044.4 | 684,408 |
| 58 | | 1,870.1 | 2.8987 | 16.27 | 10.93 | 3,310.1 | 744,135 | 3,665.4 | 824,014 | 2,846.6 | 639,941 | 3,152.2 | 708,643 |
| 59 | | 1,935.1 | 2.9994 | 16.84 | 11.31 | 3,425.1 | 769,999 | 3,792.8 | 852,654 | 2,945.6 | 662,197 | 3,261.8 | 733,282 |
| 60 | | 2,001.3 | 3.1020 | 17.41 | 11.70 | 3,542.3 | 796,341 | 3,922.5 | 881,824 | 3,046.3 | 684,835 | 3,373.3 | 758,348 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

Special constructions and diameters available – please contact us directly.

# CASAR **PARAPLAST M**



- High performance mining rope
- 8-strand construction with compacted outer strands
- Double parallel design
- Fully lubricated
- Plastic layer between steel core and outer strands
- Very high breaking force
- Good resistance to drum crushing
- Available in ordinary (regular) lay or langs lay

## PROPERTIES

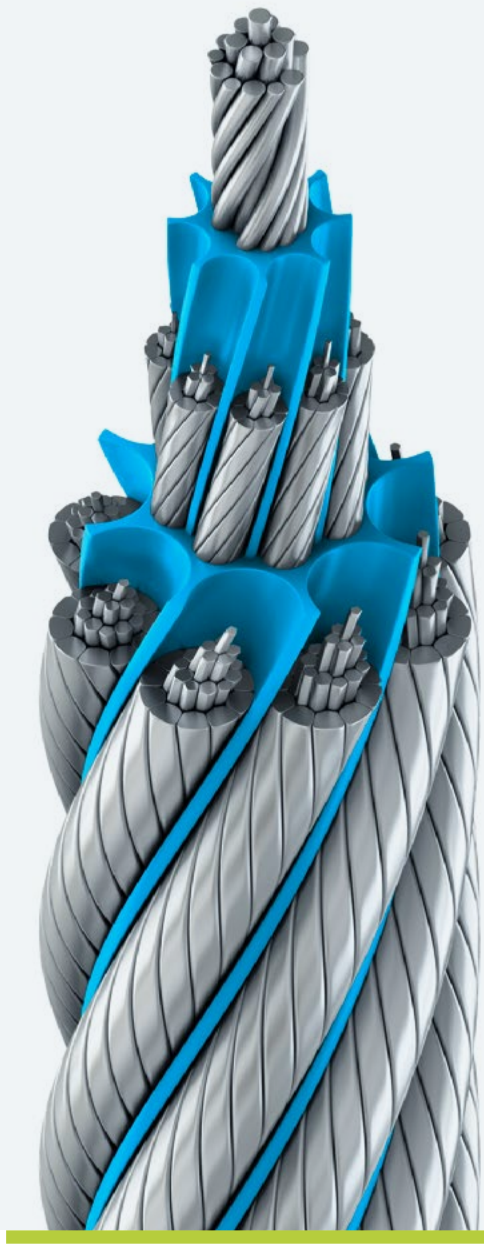
No swivel | Lubricated | Tolerance | Plast rope | Compacted

High Breaking Force | Parallel Construction | preformed

## APPLICATIONS

High performance hoist rope particularly developed for heavy duty, multi-layer drum winder applications. Our CASAR Paraplast MD is a double parallel, very durable rope design to provide an excellent flexibility with a very high breaking force and a good resistance to drum crushing.

Drum Winder | Slope Winder

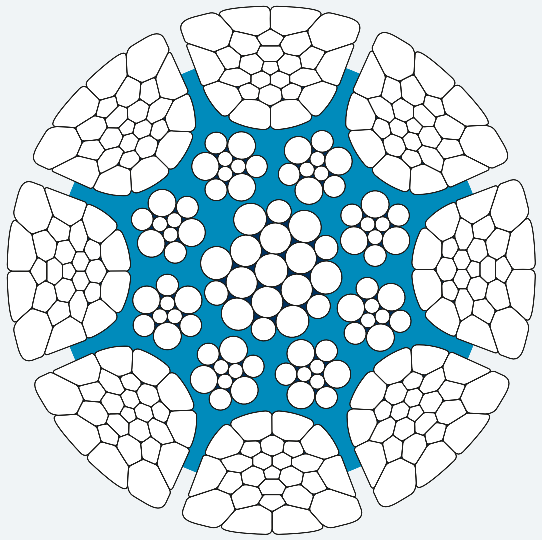


| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force 1770 N/mm² | | Aggregate Breaking Force 1960 N/mm² | | Minimum Breaking Force 1770 N/mm² | | Minimum Breaking Force 1960 N/mm² | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 220.1 | 0.3412 | 2.01 | 1.35 | 389.6 | 87,580 | 431.4 | 96,982 | 342.9 | 77,087 | 379.7 | 85,362 |
| 21 | | 240.4 | 0.3726 | 2.20 | 1.48 | 425.5 | 95,658 | 471.2 | 105,926 | 374.5 | 84,191 | 414.7 | 93,228 |
| 22 | | 264.8 | 0.4104 | 2.40 | 1.61 | 468.7 | 105,367 | 519.0 | 116,678 | 412.5 | 92,734 | 456.8 | 102,688 |
| | 7/8 | 270.2 | 0.4189 | 2.45 | 1.65 | 478.3 | 107,533 | 529.7 | 119,076 | 421.0 | 94,640 | 466.2 | 104,799 |
| 23 | | 299.8 | 0.4647 | 2.64 | 1.77 | 530.6 | 119,294 | 587.6 | 132,100 | 467.0 | 104,986 | 517.1 | 116,255 |
| 24 | | 325.7 | 0.5048 | 2.87 | 1.93 | 576.5 | 129,600 | 638.4 | 143,512 | 507.3 | 114,046 | 561.8 | 126,288 |
| 25 | | 353.1 | 0.5473 | 3.11 | 2.09 | 625.0 | 140,503 | 692.1 | 155,585 | 550.0 | 123,645 | 609.0 | 136,918 |
| | 1 | 364.5 | 0.5650 | 3.21 | 2.16 | 645.1 | 145,035 | 714.4 | 160,603 | 567.7 | 127,633 | 628.7 | 141,334 |
| 26 | | 383.9 | 0.5950 | 3.38 | 2.27 | 679.5 | 152,758 | 752.4 | 169,156 | 598.0 | 134,436 | 662.2 | 148,867 |
| 27 | | 412.3 | 0.6391 | 3.63 | 2.44 | 729.8 | 164,059 | 808.1 | 181,670 | 642.1 | 144,350 | 711.0 | 159,845 |
| 28 | | 441.0 | 0.6836 | 3.89 | 2.61 | 780.6 | 175,479 | 864.4 | 194,316 | 686.8 | 154,399 | 760.6 | 170,990 |
| | 1 1/8 | 459.3 | 0.7119 | 4.05 | 2.72 | 813.0 | 182,760 | 900.2 | 202,379 | 715.3 | 160,805 | 792.2 | 178,085 |
| 29 | | 475.6 | 0.7372 | 4.18 | 2.81 | 841.8 | 189,247 | 932.2 | 209,561 | 740.8 | 166,538 | 820.3 | 184,415 |
| 30 | | 512.5 | 0.7944 | 4.49 | 3.02 | 907.1 | 203,930 | 1,004.5 | 225,821 | 798.3 | 179,465 | 884.0 | 198,730 |
| 31 | | 546.6 | 0.8473 | 4.78 | 3.21 | 967.5 | 217,507 | 1,071.4 | 240,855 | 841.7 | 189,222 | 921.4 | 207,139 |
| | 1 1/4 | 573.4 | 0.8888 | 5.01 | 3.37 | 1,014.9 | 228,158 | 1,123.8 | 252,650 | 882.9 | 198,488 | 966.5 | 217,283 |
| 32 | | 580.4 | 0.8996 | 5.11 | 3.43 | 1,027.3 | 230,936 | 1,137.5 | 255,726 | 893.7 | 200,912 | 978.3 | 219,931 |
| 33 | | 618.5 | 0.9587 | 5.45 | 3.66 | 1,094.7 | 246,108 | 1,212.3 | 272,527 | 952.4 | 214,108 | 1,042.5 | 234,363 |
| 34 | | 650.8 | 1.0087 | 5.75 | 3.86 | 1,151.9 | 258,961 | 1,275.6 | 286,759 | 1,002.2 | 225,303 | 1,097.0 | 246,615 |
| | 1 3/8 | 686.7 | 1.0644 | 6.07 | 4.08 | 1,215.4 | 273,243 | 1,345.9 | 302,574 | 1,057.5 | 237,729 | 1,157.5 | 260,217 |
| 35 | | 690.5 | 1.0702 | 6.11 | 4.11 | 1,222.1 | 274,746 | 1,353.3 | 304,239 | 1,063.3 | 239,039 | 1,163.9 | 261,655 |
| 36 | | 732.0 | 1.1346 | 6.42 | 4.31 | 1,295.6 | 291,267 | 1,434.7 | 322,533 | 1,127.2 | 253,405 | 1,233.8 | 277,369 |
| 37 | | 770.8 | 1.1947 | 6.78 | 4.56 | 1,364.3 | 306,706 | 1,510.7 | 339,630 | 1,186.9 | 266,826 | 1,299.2 | 292,072 |
| 38 | 1 1/2 | 817.0 | 1.2664 | 7.20 | 4.84 | 1,446.1 | 325,106 | 1,601.4 | 360,004 | 1,258.1 | 282,832 | 1,377.2 | 309,607 |
| 39 | | 851.5 | 1.3199 | 7.58 | 5.09 | 1,507.2 | 338,834 | 1,669.0 | 375,206 | 1,311.3 | 294,792 | 1,435.3 | 322,668 |
| 40 | | 909.7 | 1.4101 | 7.98 | 5.36 | 1,610.2 | 361,996 | 1,783.1 | 400,855 | 1,400.9 | 314,935 | 1,533.5 | 344,744 |
| | 1 5/8 | 968.7 | 1.5014 | 8.50 | 5.71 | 1,714.5 | 385,441 | 1,898.6 | 426,816 | 1,491.6 | 335,332 | 1,632.8 | 367,072 |
| 42 | | 996.8 | 1.5450 | 8.78 | 5.90 | 1,764.3 | 396,623 | 1,953.6 | 439,198 | 1,534.9 | 345,059 | 1,680.1 | 377,701 |
| 44 | | 1,098.4 | 1.7025 | 9.64 | 6.48 | 1,944.1 | 437,054 | 2,152.8 | 483,970 | 1,691.4 | 380,242 | 1,851.4 | 416,211 |
| | 1 3/4 | 1,121.0 | 1.7375 | 9.84 | 6.61 | 1,984.1 | 446,040 | 2,197.1 | 493,920 | 1,726.2 | 388,059 | 1,889.5 | 424,768 |
| 46 | | 1,200.0 | 1.8600 | 10.54 | 7.08 | 2,124.1 | 477,506 | 2,352.1 | 528,764 | 1,847.9 | 415,424 | 2,022.8 | 454,743 |
| | 1 7/8 | 1,286.3 | 1.9938 | 11.30 | 7.59 | 2,276.8 | 511,839 | 2,521.2 | 566,782 | 1,980.8 | 445,293 | 2,168.2 | 487,440 |
| 48 | | 1,306.4 | 2.0249 | 11.46 | 7.70 | 2,312.3 | 519,820 | 2,560.5 | 575,620 | 2,011.7 | 452,248 | 2,202.0 | 495,029 |
| 50 | | 1,403.3 | 2.1751 | 12.52 | 8.41 | 2,483.8 | 558,374 | 2,750.4 | 618,312 | 2,160.9 | 485,790 | 2,365.3 | 531,740 |
| 51 | 2 | 1,453.8 | 2.2535 | 12.85 | 8.63 | 2,573.3 | 578,502 | 2,849.5 | 640,601 | 2,238.8 | 503,297 | 2,450.6 | 550,917 |
| 52 | | 1,523.3 | 2.3612 | 13.46 | 9.05 | 2,696.3 | 606,156 | 2,985.8 | 671,223 | 2,345.8 | 527,355 | 2,567.7 | 577,252 |
| 53 | | 1,582.5 | 2.4529 | 13.99 | 9.40 | 2,801.0 | 629,694 | 3,101.7 | 697,288 | 2,436.9 | 547,833 | 2,667.5 | 599,667 |
| 54 | 2 1/8 | 1,641.3 | 2.5439 | 14.51 | 9.75 | 2,905.0 | 653,075 | 3,216.9 | 723,179 | 2,527.4 | 568,175 | 2,766.5 | 621,934 |
| 55 | | 1,704.2 | 2.6415 | 15.06 | 10.12 | 3,016.4 | 678,114 | 3,340.2 | 750,906 | 2,624.3 | 589,959 | 2,872.6 | 645,779 |
| 56 | | 1,766.7 | 2.7384 | 15.61 | 10.49 | 3,127.1 | 702,997 | 3,462.8 | 778,460 | 2,720.6 | 611,607 | 2,978.0 | 669,476 |
| 57 | 2 1/4 | 1,840.0 | 2.8520 | 16.26 | 10.93 | 3,256.8 | 732,167 | 3,606.4 | 810,761 | 2,833.5 | 636,985 | 3,101.5 | 697,254 |
| 58 | | 1,895.2 | 2.9375 | 16.75 | 11.26 | 3,354.4 | 754,108 | 3,714.5 | 835,057 | 2,918.4 | 656,074 | 3,194.5 | 718,149 |
| 59 | | 1,961.1 | 3.0397 | 17.33 | 11.65 | 3,471.1 | 780,336 | 3,843.7 | 864,101 | 3,019.9 | 678,892 | 3,305.6 | 743,127 |
| 60 | | 2,028.1 | 3.1436 | 17.92 | 12.04 | 3,589.8 | 807,012 | 3,975.1 | 893,640 | 3,123.1 | 702,100 | 3,418.6 | 768,531 |
| | 2 3/8 | 2,050.1 | 3.1777 | 18.12 | 12.18 | 3,628.8 | 815,778 | 4,018.3 | 903,348 | 3,157.0 | 709,727 | 3,455.7 | 776,879 |
| 61 | | 2,096.3 | 3.2492 | 18.53 | 12.45 | 3,710.4 | 834,137 | 4,108.7 | 923,677 | 3,228.1 | 725,699 | 3,533.5 | 794,362 |
| 62 | | 2,165.6 | 3.3566 | 19.14 | 12.86 | 3,833.1 | 861,709 | 4,244.5 | 954,209 | 3,334.8 | 749,687 | 3,650.3 | 820,620 |
| 63 | | 2,236.0 | 3.4658 | 19.76 | 13.28 | 3,957.7 | 889,731 | 4,382.6 | 985,239 | 3,443.2 | 774,066 | 3,769.0 | 847,305 |
| | 2 ½ | 2,271.6 | 3.5210 | 20.08 | 13.49 | 4,020.8 | 903,909 | 4,452.4 | 1,000,939 | 3,498.1 | 786,401 | 3,829.1 | 860,808 |
| 64 | | 2,307.5 | 3.5767 | 20.39 | 13.70 | 4,084.4 | 918,200 | 4,522.8 | 1,016,764 | 3,553.4 | 798,834 | 3,889.6 | 874,417 |
| 65 | | 2,380.2 | 3.6893 | 21.04 | 14.14 | 4,213.0 | 947,118 | 4,665.2 | 1,048,786 | 3,665.3 | 823,993 | 4,058.8 | 912,444 |

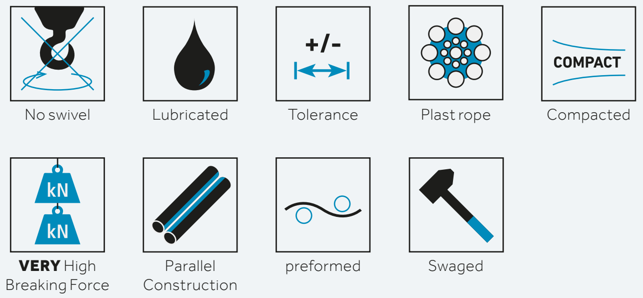
Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

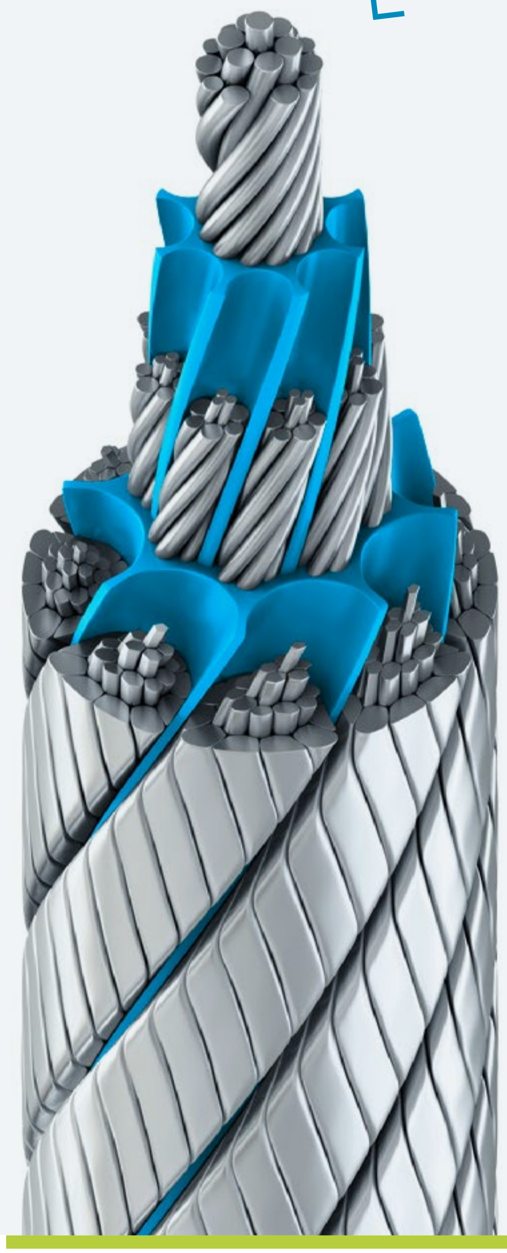
# CASAR **PARAFIT**

- High performance mining rope
- Swaged 8-strand construction with compacted outer strands
- Double parallel design
- Fully lubricated
- Plastic layer between steel core and outer strands
- Extremely high breaking force
- Good resistance to drum crushing
- Available in ordinary (regular) lay or langs lay



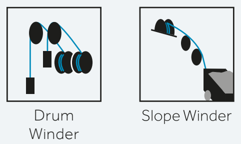

## PROPERTIES



## APPLICATIONS

High performance hoist rope particularly developed for heavy duty, multi-layer drum winder applications. Our CASAR Parafit MD is cold swaged after manufacture that makes it a very durable rope design with an extremely high breaking force and an excellent flexibility. This innovative rope design provides an increased surface contact area and provides maximum resistance against abrasion and crushing.
Less recommended for koepe friction winder applications.




| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force 1770 N/mm² | | Aggregate Breaking Force 1960 N/mm² | | Minimum Breaking Force 1770 N/mm² | | Minimum Breaking Force 1960 N/mm² | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 233.7 | 0.3622 | 1.99 | 1.34 | 413.6 | 92,992 | 458.1 | 102,974 | 359.8 | 80,894 | 398.5 | 89,575 |
| 21 | | 256.5 | 0.3976 | 2.18 | 1.46 | 454.0 | 102,064 | 502.7 | 113,020 | 394.9 | 88,786 | 437.5 | 98,343 |
| 22 | | 284.5 | 0.4410 | 2.42 | 1.63 | 503.6 | 113,206 | 557.6 | 125,358 | 438.1 | 98,478 | 485.2 | 109,066 |
| | 7/8 | 290.3 | 0.4500 | 2.47 | 1.66 | 513.9 | 115,533 | 569.1 | 127,935 | 447.1 | 100,502 | 495.1 | 111,308 |
| 23 | | 309.8 | 0.4802 | 2.63 | 1.77 | 548.3 | 123,273 | 607.2 | 136,506 | 477.0 | 107,235 | 528.3 | 118,764 |
| 24 | | 337.9 | 0.5237 | 2.87 | 1.93 | 598.1 | 134,454 | 662.3 | 148,887 | 520.3 | 116,962 | 576.1 | 129,517 |
| 25 | | 366.2 | 0.5676 | 3.11 | 2.09 | 648.2 | 145,715 | 717.8 | 161,357 | 563.8 | 126,758 | 624.4 | 140,371 |
| | 1 | 378.0 | 0.5859 | 3.21 | 2.16 | 669.1 | 150,415 | 740.9 | 166,562 | 582.0 | 130,846 | 644.5 | 144,898 |
| 26 | | 393.9 | 0.6105 | 3.35 | 2.25 | 697.2 | 156,737 | 772.0 | 173,562 | 606.5 | 136,346 | 671.7 | 151,006 |
| 27 | | 426.5 | 0.6611 | 3.63 | 2.44 | 754.9 | 169,709 | 835.9 | 187,927 | 656.7 | 147,630 | 727.2 | 163,483 |
| 28 | | 459.1 | 0.7116 | 3.90 | 2.62 | 812.6 | 182,681 | 899.8 | 202,291 | 706.9 | 158,914 | 782.8 | 175,976 |
| | 1 1/8 | 478.1 | 0.7411 | 4.06 | 2.73 | 846.3 | 190,261 | 937.2 | 210,685 | 736.2 | 165,508 | 815.3 | 183,278 |
| 29 | | 491.5 | 0.7618 | 4.18 | 2.81 | 870.0 | 195,574 | 963.3 | 216,567 | 756.8 | 170,129 | 838.0 | 188,399 |
| 30 | | 529.1 | 0.8201 | 4.50 | 3.02 | 936.5 | 210,535 | 1,037.0 | 233,135 | 814.7 | 183,144 | 902.2 | 202,832 |
| | | 565.0 | 0.8757 | 4.81 | 3.23 | 1,000.0 | 224,805 | 1,107.3 | 248,936 | 869.9 | 195,558 | 963.4 | 216,579 |
| 32 | 1 1/4 | 597.5 | 0.9261 | 5.08 | 3.41 | 1,057.6 | 237,752 | 1,171.1 | 263,274 | 920.0 | 206,821 | 1,018.9 | 229,065 |
| 34 | | 678.7 | 1.0520 | 5.77 | 3.88 | 1,201.3 | 270,063 | 1,330.3 | 299,052 | 1,045.0 | 234,928 | 1,157.3 | 260,174 |
| | 1 3/8 | 716.1 | 1.1100 | 6.09 | 4.09 | 1,267.6 | 284,957 | 1,403.6 | 315,546 | 1,102.6 | 247,884 | 1,221.1 | 274,523 |
| 36 | | 757.5 | 1.1741 | 6.44 | 4.33 | 1,340.8 | 301,418 | 1,484.7 | 333,774 | 1,166.3 | 262,204 | 1,291.6 | 290,365 |
| 38 | | 848.2 | 1.3147 | 7.21 | 4.85 | 1,501.3 | 337,509 | 1,662.5 | 373,739 | 1,306.0 | 293,599 | 1,446.4 | 325,152 |
| | 1 1/2 | 852.7 | 1.3216 | 7.25 | 4.87 | 1,509.2 | 339,287 | 1,671.2 | 375,708 | 1,312.9 | 295,146 | 1,454.0 | 326,866 |
| 40 | | 934.7 | 1.4488 | 7.95 | 5.34 | 1,654.4 | 371,928 | 1,832.0 | 411,853 | 1,439.2 | 323,540 | 1,593.8 | 358,309 |
| | 1 5/8 | 995.2 | 1.5426 | 8.46 | 5.69 | 1,761.6 | 396,016 | 1,950.7 | 438,527 | 1,532.4 | 344,495 | 1,697.1 | 381,516 |
| 42 | | 1,030.5 | 1.5973 | 8.76 | 5.89 | 1,824.0 | 410,048 | 2,019.8 | 454,065 | 1,586.7 | 356,701 | 1,757.2 | 395,032 |
| 43 | | 1,080.2 | 1.6742 | 9.19 | 6.17 | 1,911.9 | 429,807 | 2,117.1 | 475,944 | 1,663.1 | 373,889 | 1,841.9 | 414,067 |
| 44 | | 1,137.6 | 1.7633 | 9.68 | 6.50 | 2,013.6 | 452,664 | 2,229.7 | 501,256 | 1,751.6 | 393,773 | 1,939.8 | 436,089 |
| | 1 3/4 | 1,161.0 | 1.7995 | 9.87 | 6.64 | 2,054.9 | 461,971 | 2,275.5 | 511,561 | 1,787.6 | 401,868 | 1,979.7 | 445,054 |
| 46 | | 1,240.8 | 1.9232 | 10.55 | 7.09 | 2,196.2 | 493,729 | 2,432.0 | 546,728 | 1,910.5 | 429,495 | 2,115.8 | 475,642 |
| | 1 7/8 | 1,330.0 | 2.0615 | 11.31 | 7.60 | 2,354.1 | 529,228 | 2,606.8 | 586,038 | 2,047.9 | 460,375 | 2,267.9 | 509,840 |
| 48 | | 1,351.3 | 2.0945 | 11.49 | 7.72 | 2,391.8 | 537,698 | 2,648.5 | 595,417 | 2,080.6 | 467,744 | 2,304.2 | 517,996 |
| 50 | | 1,454.6 | 2.2546 | 12.37 | 8.31 | 2,574.6 | 578,802 | 2,851.0 | 640,934 | 2,239.7 | 503,500 | 2,480.3 | 557,591 |
| 51 | 2 | 1,512.0 | 2.3436 | 12.86 | 8.64 | 2,676.3 | 601,649 | 2,963.5 | 666,232 | 2,328.1 | 523,374 | 2,578.0 | 579,556 |
| 52 | | 1,584.3 | 2.4557 | 13.47 | 9.05 | 2,804.2 | 630,409 | 3,105.2 | 698,080 | 2,439.4 | 548,392 | 2,701.2 | 607,259 |
| 53 | | 1,645.8 | 2.5510 | 13.99 | 9.40 | 2,913.1 | 654,888 | 3,225.8 | 725,187 | 2,534.1 | 569,687 | 2,806.1 | 630,840 |
| 54 | 2 1/8 | 1,706.9 | 2.6457 | 14.51 | 9.75 | 3,021.3 | 679,205 | 3,345.6 | 752,114 | 2,628.2 | 590,840 | 2,910.3 | 654,264 |
| 55 | | 1,772.4 | 2.7472 | 15.07 | 10.13 | 3,137.1 | 705,246 | 3,473.8 | 780,951 | 2,729.0 | 613,494 | 3,021.9 | 679,349 |
| 56 | | 1,837.4 | 2.8480 | 15.62 | 10.50 | 3,252.2 | 731,125 | 3,601.3 | 809,607 | 2,829.1 | 636,005 | 3,132.8 | 704,277 |
| 57 | 2 1/4 | 1,913.6 | 2.9661 | 16.27 | 10.93 | 3,387.2 | 761,461 | 3,750.7 | 843,200 | 2,946.5 | 662,395 | 3,262.8 | 733,500 |
| 58 | | 1,971.0 | 3.0550 | 16.76 | 11.26 | 3,488.7 | 784,281 | 3,863.1 | 868,469 | 3,034.8 | 682,246 | 3,360.5 | 755,481 |
| 59 | | 2,039.5 | 3.1613 | 17.34 | 11.65 | 3,610.0 | 811,558 | 3,997.5 | 898,674 | 3,140.3 | 705,974 | 3,477.4 | 781,757 |
| 60 | | 2,109.3 | 3.2694 | 17.94 | 12.05 | 3,733.4 | 839,301 | 4,134.2 | 929,396 | 3,247.7 | 730,108 | 3,596.3 | 808,482 |
| | 2 3/8 | 2,132.2 | 3.3049 | 18.13 | 12.18 | 3,774.0 | 848,419 | 4,179.1 | 939,492 | 3,283.0 | 738,039 | 3,635.4 | 817,264 |
| 61 | | 2,180.2 | 3.3792 | 18.54 | 12.46 | 3,858.9 | 867,511 | 4,273.1 | 960,634 | 3,356.8 | 754,648 | 3,717.2 | 835,656 |
| 62 | | 2,252.2 | 3.4910 | 19.15 | 12.87 | 3,986.4 | 896,187 | 4,414.4 | 992,388 | 3,467.8 | 779,593 | 3,840.1 | 863,279 |
| 63 | | 2,325.5 | 3.6045 | 19.77 | 13.29 | 4,116.1 | 925,330 | 4,557.9 | 1,024,659 | 3,580.6 | 804,944 | 3,964.9 | 891,351 |
| | 2 ½ | 2,362.5 | 3.6619 | 20.09 | 13.50 | 4,181.7 | 940,076 | 4,630.5 | 1,040,988 | 3,637.6 | 817,772 | 4,028.1 | 905,555 |
| 64 | | 2,399.9 | 3.7198 | 20.41 | 13.71 | 4,247.8 | 954,939 | 4,703.8 | 1,057,446 | 3,695.1 | 830,701 | 4,091.8 | 919,872 |
| 65 | | 2,475.5 | 3.8370 | 21.05 | 14.14 | 4,381.6 | 985,014 | 4,851.9 | 1,090,749 | 3,811.5 | 856,863 | 4,220.7 | 948,843 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

Special constructions and diameters available – please contact us directly.

# CASAR DUROPLAST KEEPS THE MINE RUNNING AT A 300% COST SAVING

**Time is money. On this basis, the Australian Zinc Mine wanted to optimize production costs. With the help of Casar engineers and a specially developed rope, all expectations were exceeded.**

Ropes for hoisting plant systems place special demands on the rope used. Since the introduction of steel cables in mining operations over 150 years ago, the performance and the achievable service life have been continuously improved. But even in our modern times, significant improvements can still be achieved. The basis is a deep understanding of the requirements in the conveyor system, paired with excellent knowledge of special steel wire ropes. Most Australian mining companies are struggling with high production costs, which can only be offset by trouble-free operation and an overall high production rate. Every interruption due to maintenance, inspection and rope change leads to losses in production and must be reduced to a minimum without endangering the hard-earned safety level in the mine. The performance of the rope is of particular importance here. The clearly defined goal was therefore to reduce wear and tear and generally to achieve a higher number of bending cycles, of course with the same or even improved safety level.

To meet these edge conditions, the engineers designed a special variant of the well tried and tested Turboplast M product with thicker wires in the outer strands that allow for greater abrasion and an increased level of resistance against radial pressure. Of course, the Duroplast M also has what CASAR specialises in, a coating of the rope core with a special plastic layer. The results speak for themselves. By using the CASAR rope, savings of over 300% were achieved across all costs. The running time of the ropes has increased from 17 months to 59 months and the number of cycles has increased fivefold! An impressive testimony to the performance of the CASAR ropes.

**Duroplast M Lifetime:**
59 Months
**Duroplast M Cycles:**
388,000 Cycles

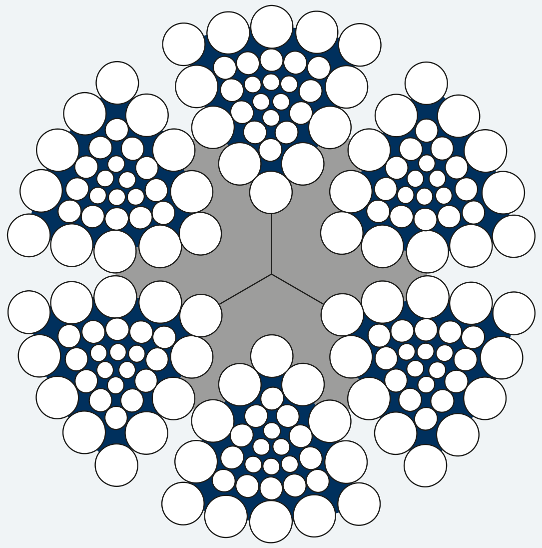
## 3.5 TIMES LONGER SERVICE LIFE, 5.5 TIMES HIGHER CYCLES

**Cost saving total:
340% less for Duroplast M
compared to previous rope.**

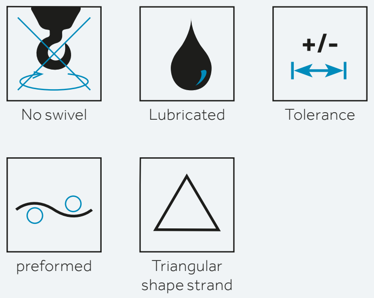
**Original Lifetime:**
17.0 Months
**Original Cycles:**
70,000 Cycles

# CASAR **TRIANGULAR STRAND**

- Special mining rope
- 6-strand design with triangular shaped outer strands
- Provides a "flat" surface on sheave and drum areas
- Compact design resists crushing and distortion under heavy loads
- Reduces wear on sheaves and drums
- Available with either fiber core or IWRC
- Fully lubricated



## PROPERTIES



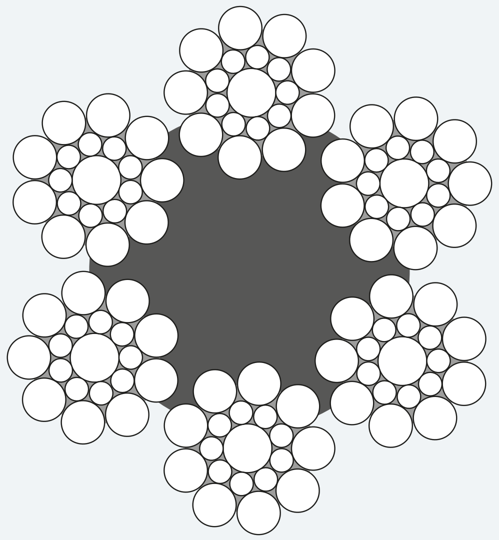

## APPLICATIONS

Our special triangular (flattened) strand ropes are custom designed and adjusted to diameter and weight requirements and customers' country standards. Tensile strengths are selected to meet certain efficiency or breaking force requirements. Our triangular strand ropes provide a "flat" strand surface on sheave and drum areas, exposing four times more wearing surface than round strand, reducing abrasion and applied unit pressure. The compact design resists crushing and distortion under heavy loads and produces 10 percent greater strength over a standard 6-strand rope. These properties make this product a very proven hoist rope for a wide range of drum and koepe friction winder applications.


| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force 1770 N/mm² | | Aggregate Breaking Force 1960 N/mm² | | Minimum Breaking Force 1770 N/mm² | | Minimum Breaking Force 1960 N/mm² | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 21 | | 195.0 | 0.3023 | 1.77 | 1.19 | 345.1 | 77,582 | 382.0 | 85,877 | 290.0 | 65,195 | 321.0 | 72,164 |
| 22 | | 214.0 | 0.3317 | 1.94 | 1.30 | 378.4 | 85,068 | 418.9 | 94,173 | 318.0 | 71,490 | 352.0 | 79,133 |
| 23 | | 234.0 | 0.3627 | 2.13 | 1.43 | 412.9 | 92,824 | 458.2 | 103,008 | 347.0 | 78,009 | 385.0 | 86,552 |
| 24 | | 255.0 | 0.3953 | 2.32 | 1.56 | 449.8 | 101,120 | 498.6 | 112,090 | 378.0 | 84,978 | 419.0 | 94,195 |
| 25 | | 281.0 | 0.4356 | 2.53 | 1.70 | 487.9 | 109,685 | 540.3 | 121,465 | 410.0 | 92,172 | 454.0 | 102,064 |
| 26 | | 304.0 | 0.4712 | 2.74 | 1.84 | 549.9 | 123,623 | 595.2 | 133,807 | 462.1 | 103,885 | 500.2 | 112,450 |
| 27 | | 328.0 | 0.5084 | 2.95 | 1.98 | 600.1 | 134,908 | 655.8 | 147,430 | 504.3 | 113,372 | 551.1 | 123,893 |
| 28 | | 353.0 | 0.5472 | 3.17 | 2.13 | 643.1 | 144,575 | 697.8 | 156,872 | 540.4 | 121,487 | 586.4 | 131,829 |
| 29 | | 378.0 | 0.5859 | 3.43 | 2.30 | 695.5 | 156,355 | 760.0 | 170,856 | 584.5 | 131,401 | 638.7 | 143,586 |
| 30 | | 405.0 | 0.6278 | 3.63 | 2.44 | 732.9 | 164,763 | 800.9 | 180,050 | 615.9 | 138,460 | 673.1 | 151,320 |
| 32 | | 460.0 | 0.7130 | 4.14 | 2.78 | 837.3 | 188,233 | 908.6 | 204,262 | 703.6 | 158,176 | 763.5 | 171,642 |
| 33 | | 490.0 | 0.7595 | 4.38 | 2.94 | 890.0 | 200,081 | 972.8 | 218,695 | 747.9 | 168,135 | 817.5 | 183,782 |
| 34 | | 520.0 | 0.8060 | 4.68 | 3.14 | 946.2 | 212,715 | 1,034.1 | 232,476 | 795.1 | 178,746 | 869.0 | 195,360 |
| 35 | | 551.0 | 0.8541 | 4.94 | 3.32 | 996.4 | 224,001 | 1,088.7 | 244,751 | 837.3 | 188,233 | 914.8 | 205,656 |
| 36 | | 581.0 | 0.9006 | 5.23 | 3.51 | 1,046.1 | 235,174 | 1,141.1 | 256,531 | 879.1 | 197,630 | 958.9 | 215,570 |
| 37 | | 616.0 | 0.9548 | 5.55 | 3.73 | 1,123.3 | 252,529 | 1,224.4 | 275,257 | 943.9 | 212,198 | 1,028.9 | 231,307 |
| 38 | | 649.0 | 1.0060 | 5.84 | 3.92 | 1,191.3 | 267,816 | 1,292.7 | 290,612 | 1,001.1 | 225,057 | 1,086.3 | 244,211 |
| 39 | | 684.0 | 1.0602 | 6.20 | 4.17 | 1,255.2 | 282,182 | 1,364.9 | 306,843 | 1,054.8 | 237,130 | 1,147.0 | 257,857 |
| 40 | | 720.0 | 1.1160 | 6.40 | 4.30 | 1,290.8 | 290,185 | 1,390.1 | 312,508 | 1,077.8 | 242,300 | 1,160.7 | 260,937 |
| 41 | | 756.0 | 1.1718 | 6.83 | 4.59 | 1,368.5 | 307,652 | 1,481.8 | 333,123 | 1,142.7 | 256,890 | 1,237.3 | 278,157 |
| 42 | | 792.0 | 1.2276 | 7.10 | 4.77 | 1,432.8 | 322,108 | 1,551.5 | 348,793 | 1,196.4 | 268,963 | 1,295.5 | 291,241 |
| 43 | | 834.0 | 1.2927 | 7.48 | 5.03 | 1,504.9 | 338,317 | 1,629.8 | 366,395 | 1,256.6 | 282,496 | 1,360.9 | 305,944 |
| 44 | | 871.0 | 1.3501 | 7.81 | 5.25 | 1,564.1 | 351,625 | 1,684.8 | 378,760 | 1,306.1 | 293,624 | 1,406.8 | 316,263 |
| 45 | | 909.0 | 1.4090 | 8.19 | 5.50 | 1,627.3 | 365,833 | 1,752.8 | 394,047 | 1,358.8 | 305,472 | 1,463.6 | 329,032 |
| 46 | | 950.0 | 1.4725 | 8.53 | 5.73 | 1,734.4 | 389,910 | 1,871.5 | 420,732 | 1,448.2 | 325,570 | 1,562.7 | 351,311 |
| 47 | | 992.0 | 1.5376 | 8.90 | 5.98 | 1,799.5 | 404,546 | 1,941.6 | 436,491 | 1,502.6 | 337,800 | 1,621.3 | 364,484 |
| 48 | | 1,037.0 | 1.6074 | 9.30 | 6.25 | 1,853.0 | 416,573 | 1,995.8 | 448,676 | 1,547.3 | 347,849 | 1,666.5 | 374,646 |
| 49 | | 1,081.0 | 1.6756 | 9.77 | 6.57 | 1,932.4 | 434,423 | 2,080.6 | 467,740 | 1,613.6 | 362,753 | 1,737.3 | 390,562 |
| 50 | | 1,125.0 | 1.7438 | 10.09 | 6.78 | 2,021.7 | 454,498 | 2,177.3 | 489,479 | 1,688.1 | 379,502 | 1,818.0 | 408,705 |
| 51 | | 1,171.0 | 1.8151 | 10.49 | 7.05 | 2,105.1 | 473,248 | 2,267.7 | 509,802 | 1,747.0 | 392,743 | 1,881.9 | 423,070 |
| 52 | | 1,222.0 | 1.8941 | 10.93 | 7.34 | 2,184.0 | 490,985 | 2,352.2 | 528,798 | 1,812.4 | 407,446 | 1,952.1 | 438,852 |
| 53 | | 1,267.0 | 1.9639 | 11.24 | 7.55 | 2,258.4 | 507,711 | 2,432.5 | 546,850 | 1,874.2 | 421,339 | 2,018.7 | 453,824 |
| 54 | | 1,316.0 | 2.0398 | 11.72 | 7.88 | 2,356.3 | 529,720 | 2,533.8 | 569,624 | 1,955.5 | 439,616 | 2,102.8 | 472,730 |
| 55 | | 1,365.0 | 2.1158 | 12.11 | 8.14 | 2,429.6 | 546,198 | 2,616.6 | 588,238 | 2,016.2 | 453,262 | 2,171.5 | 488,175 |
| 56 | | 1,415.0 | 2.1933 | 12.59 | 8.46 | 2,535.4 | 569,983 | 2,730.8 | 613,911 | 2,104.1 | 473,023 | 2,266.2 | 509,464 |
| 57 | | 1,466.0 | 2.2723 | 13.05 | 8.77 | 2,615.4 | 587,968 | 2,817.0 | 633,290 | 2,170.4 | 487,928 | 2,337.7 | 525,538 |
| 58 | | 1,518.0 | 2.3529 | 13.51 | 9.08 | 2,725.1 | 612,630 | 2,935.4 | 659,907 | 2,261.5 | 508,408 | 2,436.1 | 547,660 |
| 59 | | 1,571.0 | 2.4351 | 13.99 | 9.40 | 2,834.0 | 637,112 | 3,047.8 | 685,176 | 2,351.9 | 528,731 | 2,529.3 | 568,612 |
| 60 | | 1,625.0 | 2.5188 | 14.43 | 9.70 | 2,882.6 | 648,037 | 3,105.0 | 698,035 | 2,392.2 | 537,790 | 2,576.8 | 579,290 |

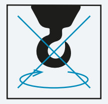
Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

# CASAR **6X19**

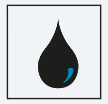


- Proven and reliable rope construction
- According to EN12385-6
- Available in galvanized and bright
- Available in ordinary (regular) lay or langs lay
- Available with either fiber core or IWRC
- Fully lubricated

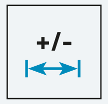
## PROPERTIES



No swivel



Lubricated

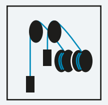



Tolerance

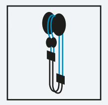
preformed

## APPLICATIONS

The very competitive 6x19 standard rope design is a proven and reliable rope with a wide range of applications.



Drum Winder



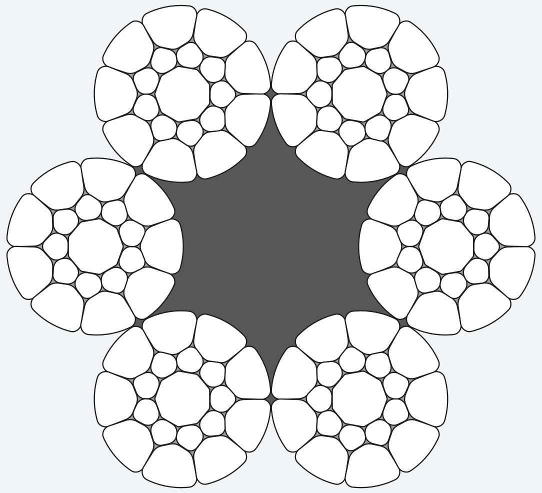
Koepe Winder head rope

| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force 1770 N/mm² | | Aggregate Breaking Force 1960 N/mm² | | Minimum Breaking Force 1770 N/mm² | | Minimum Breaking Force 1960 N/mm² | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 160.0 | 0.2480 | 1.47 | 0.99 | 283.0 | 63,621 | 314.0 | 70,590 | 246.0 | 55,303 | 273.0 | 61,373 |
| 22 | | 194.0 | 0.3007 | 1.78 | 1.20 | 343.0 | 77,110 | 380.0 | 85,428 | 298.0 | 66,993 | 330.0 | 74,187 |
| | 7/8 | 198.0 | 0.3069 | 1.81 | 1.22 | 350.0 | 78,684 | 388.0 | 87,226 | 304.0 | 68,342 | 337.0 | 75,761 |
| 24 | | 230.0 | 0.3565 | 2.10 | 1.41 | 407.0 | 91,498 | 451.0 | 101,389 | 355.0 | 79,807 | 393.0 | 88,350 |
| 25 | | 250.0 | 0.3875 | 2.30 | 1.55 | 443.0 | 99,591 | 490.0 | 110,157 | 385.0 | 86,551 | 426.0 | 95,769 |
| | 1 | 258.0 | 0.3999 | 2.40 | 1.61 | 457.0 | 102,738 | 506.0 | 113,754 | 397.0 | 89,249 | 440.0 | 98,916 |
| 26 | | 270.0 | 0.4185 | 2.50 | 1.68 | 478.0 | 107,459 | 529.0 | 118,924 | 416.0 | 93,521 | 461.0 | 103,637 |
| 28 | | 314.0 | 0.4867 | 2.90 | 1.95 | 556.0 | 124,994 | 615.0 | 138,258 | 483.0 | 108,583 | 535.0 | 120,273 |
| | 1 1/8 | 327.0 | 0.5069 | 3.00 | 2.02 | 579.0 | 130,165 | 641.0 | 144,103 | 503.0 | 113,079 | 557.0 | 125,219 |
| 30 | | 360.0 | 0.5580 | 3.30 | 2.22 | 637.0 | 143,204 | 706.0 | 158,716 | 554.0 | 124,544 | 614.0 | 138,033 |
| | 1 1/4 | 403.0 | 0.6247 | 3.70 | 2.49 | 713.0 | 160,290 | 790.0 | 177,600 | 621.0 | 139,606 | 688.0 | 154,669 |
| 32 | | 410.0 | 0.6355 | 3.80 | 2.55 | 726.0 | 163,212 | 804.0 | 180,747 | 631.0 | 141,854 | 698.0 | 156,917 |
| 34 | | 462.0 | 0.7161 | 4.20 | 2.82 | 818.0 | 183,895 | 906.0 | 203,678 | 712.0 | 160,064 | 788.0 | 177,149 |
| | 1 3/8 | 488.0 | 0.7564 | 4.50 | 3.02 | 864.0 | 194,236 | 956.0 | 214,918 | 752.0 | 169,056 | 832.0 | 187,041 |
| 36 | | 518.0 | 0.8029 | 4.80 | 3.23 | 917.0 | 206,151 | 1,015.0 | 228,182 | 798.0 | 179,398 | 884.0 | 198,731 |
| 38 | 1 1/2 | 578.0 | 0.8959 | 5.30 | 3.56 | 1,023.0 | 229,981 | 1,133.0 | 254,710 | 889.0 | 199,855 | 985.0 | 221,437 |
| 40 | | 640.0 | 0.9920 | 5.90 | 3.96 | 1,133.0 | 254,710 | 1,254.0 | 281,912 | 986.0 | 221,662 | 1,090.0 | 245,042 |
| | 1 5/8 | 682.0 | 1.0571 | 6.30 | 4.23 | 1,207.0 | 271,346 | 1,337.0 | 300,571 | 1,050.0 | 236,049 | 1,160.0 | 260,778 |
| 42 | | 706.0 | 1.0943 | 6.50 | 4.37 | 1,250.0 | 281,013 | 1,384.0 | 311,137 | 1,090.0 | 245,042 | 1,200.0 | 269,771 |
| 44 | | 774.0 | 1.1997 | 7.10 | 4.77 | 1,370.0 | 307,990 | 1,517.0 | 341,037 | 1,190.0 | 267,523 | 1,320.0 | 296,748 |
| | 1 3/4 | 790.0 | 1.2245 | 7.30 | 4.91 | 1,398.0 | 314,284 | 1,548.0 | 348,006 | 1,220.0 | 274,267 | 1,350.0 | 303,492 |
| 46 | | 846.0 | 1.3113 | 7.80 | 5.24 | 1,497.0 | 336,541 | 1,658.0 | 372,735 | 1,300.0 | 292,252 | 1,440.0 | 323,725 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

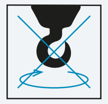
Special constructions and diameters available – please contact us directly.

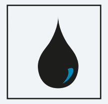
# CASAR **6X19 COMPACTED**

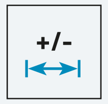


- Proven and reliable rope construction
- According to EN12385-6
- Available in galvanized and bright
- Available in ordinary (regular) lay or langs lay
- Available with either fiber core or IWRC
- Fully lubricated

## PROPERTIES

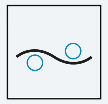

No swivel


Lubricated



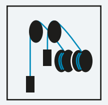
Tolerance

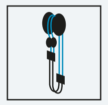
Compacted


preformed

## APPLICATIONS

The compacted 6x19 standard rope design is a proven and reliable rope with a wide range of applications.


Drum Winder


Koepe Winder head rope

| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force | | | | Minimum Breaking Force | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1770 N/mm² | | 1960 N/mm² | | 1770 N/mm² | | 1960 N/mm² | |
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 181.0 | 0.2806 | 1.70 | 1.14 | 320.0 | 71,939 | 355.0 | 79,807 | 264.0 | 59,350 | 292.0 | 65,644 |
| 22 | | 219.0 | 0.3395 | 2.10 | 1.41 | 388.0 | 87,226 | 429.0 | 96,443 | 320.0 | 71,939 | 354.0 | 79,582 |
| | 7/8 | 224.0 | 0.3472 | 2.10 | 1.41 | 396.0 | 89,024 | 439.0 | 98,691 | 326.0 | 73,288 | 361.0 | 81,156 |
| 24 | | 261.0 | 0.4046 | 2.40 | 1.61 | 462.0 | 103,862 | 512.0 | 115,102 | 380.0 | 85,427 | 421.0 | 94,645 |
| 25 | | 283.0 | 0.4387 | 2.70 | 1.81 | 501.0 | 112,629 | 555.0 | 124,769 | 413.0 | 92,846 | 457.0 | 102,738 |
| | 1 | 292.0 | 0.4526 | 2.70 | 1.81 | 517.0 | 116,226 | 572.0 | 128,591 | 426.0 | 95,769 | 472.0 | 106,110 |
| 26 | | 306.0 | 0.4743 | 2.90 | 1.95 | 542.0 | 121,846 | 600.0 | 134,885 | 446.0 | 100,265 | 494.0 | 111,056 |
| 28 | | 355.0 | 0.5503 | 3.30 | 2.22 | 628.0 | 141,180 | 696.0 | 156,467 | 518.0 | 116,451 | 573.0 | 128,815 |
| | 1 1/8 | 370.0 | 0.5735 | 3.50 | 2.35 | 655.0 | 147,250 | 725.0 | 162,986 | 539.0 | 121,172 | 597.0 | 134,211 |
| 30 | | 408.0 | 0.6324 | 3.80 | 2.55 | 722.0 | 162,312 | 800.0 | 179,847 | 594.0 | 133,536 | 658.0 | 147,924 |
| | 1 1/4 | 457.0 | 0.7084 | 4.30 | 2.89 | 809.0 | 181,870 | 896.0 | 201,429 | 666.0 | 149,723 | 737.0 | 165,684 |
| 32 | | 464.0 | 0.7192 | 4.40 | 2.96 | 821.0 | 184,568 | 909.0 | 204,351 | 676.0 | 151,971 | 749.0 | 168,382 |
| 34 | | 524.0 | 0.8122 | 4.90 | 3.29 | 927.0 | 208,398 | 1,027.0 | 230,879 | 763.0 | 171,529 | 845.0 | 189,964 |
| | 1 3/8 | 553.0 | 0.8572 | 5.20 | 3.49 | 979.0 | 220,088 | 1,084.0 | 243,693 | 806.0 | 181,196 | 892.0 | 200,530 |
| 36 | | 587.0 | 0.9099 | 5.50 | 3.70 | 1,039.0 | 233,576 | 1,151.0 | 258,755 | 856.0 | 192,436 | 947.0 | 212,894 |
| 38 | 1 1/2 | 654.0 | 1.0137 | 6.10 | 4.10 | 1,158.0 | 260,329 | 1,282.0 | 288,205 | 953.0 | 214,243 | 1,060.0 | 238,297 |
| 40 | | 725.0 | 1.1238 | 6.80 | 4.57 | 1,283.0 | 288,430 | 1,421.0 | 319,453 | 1,060.0 | 238,297 | 1,170.0 | 263,026 |
| | 1 5/8 | 772.0 | 1.1966 | 7.20 | 4.84 | 1,366.0 | 307,089 | 1,513.0 | 340,136 | 1,130.0 | 254,034 | 1,250.0 | 281,011 |
| 42 | | 799.0 | 1.2385 | 7.50 | 5.04 | 1,414.0 | 317,880 | 1,566.0 | 352,051 | 1,160.0 | 260,778 | 1,290.0 | 290,003 |
| 44 | | 877.0 | 1.3594 | 8.20 | 5.51 | 1,552.0 | 348,903 | 1,719.0 | 386,446 | 1,280.0 | 287,755 | 1,420.0 | 319,229 |

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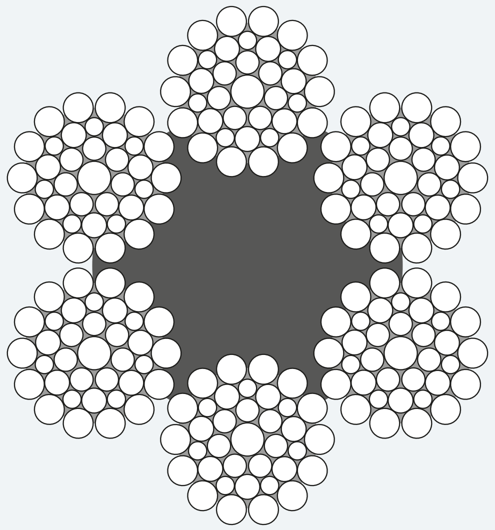
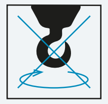
Special constructions and diameters available – please contact us directly.

# CASAR **6X36**

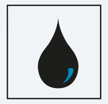


- Proven and reliable rope construction
- According to EN12385-6
- Available in galvanized and bright
- Available in ordinary (regular) lay or langs lay
- Available with either fiber core or IWRC
- Fully lubricated

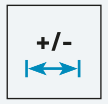
## PROPERTIES



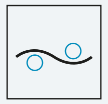
No swivel



Lubricated



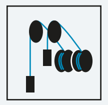

Tolerance



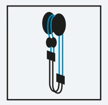
preformed

## APPLICATIONS

The very competitive 6x36 standard rope design is a proven and reliable rope with a wide range of applications.



Drum Winder



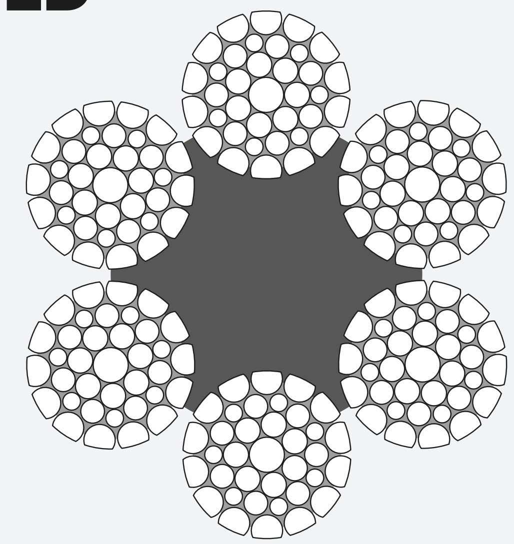
Koepe Winder head rope

| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force | | | | Minimum Breaking Force | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1770 N/mm² | | 1960 N/mm² | | 1770 N/mm² | | 1960 N/mm² | |
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 162.0 | 0.2511 | 1.51 | 1.01 | 287.0 | 64,520 | 318.0 | 71,489 | 244.0 | 54,853 | 270.0 | 60,698 |
| 22 | | 196.0 | 0.3038 | 1.83 | 1.23 | 347.0 | 78,009 | 384.0 | 86,327 | 295.0 | 66,319 | 326.0 | 73,288 |
| | 7/8 | 200.0 | 0.3100 | 1.87 | 1.26 | 354.0 | 79,582 | 392.0 | 88,125 | 301.0 | 67,667 | 333.0 | 74,861 |
| 24 | | 233.0 | 0.3612 | 2.20 | 1.48 | 412.0 | 92,621 | 457.0 | 102,738 | 351.0 | 78,908 | 388.0 | 87,226 |
| 25 | | 253.0 | 0.3922 | 2.40 | 1.61 | 448.0 | 100,714 | 496.0 | 111,505 | 381.0 | 85,652 | 421.0 | 94,645 |
| | 1 | 261.0 | 0.4046 | 2.40 | 1.61 | 462.0 | 103,862 | 512.0 | 115,102 | 393.0 | 88,350 | 435.0 | 97,792 |
| 26 | | 274.0 | 0.4247 | 2.60 | 1.75 | 485.0 | 109,032 | 537.0 | 120,722 | 412.0 | 92,621 | 456.0 | 102,513 |
| 28 | | 318.0 | 0.4929 | 3.00 | 2.02 | 563.0 | 126,567 | 623.0 | 140,056 | 477.0 | 107,234 | 529.0 | 118,924 |
| | 1 1/8 | 331.0 | 0.5131 | 3.10 | 2.08 | 586.0 | 131,738 | 649.0 | 145,901 | 497.0 | 111,730 | 551.0 | 123,870 |
| 30 | | 365.0 | 0.5658 | 3.40 | 2.28 | 646.0 | 145,227 | 715.0 | 160,738 | 548.0 | 123,195 | 607.0 | 136,459 |
| | 1 1/4 | 408.0 | 0.6324 | 3.80 | 2.55 | 722.0 | 162,312 | 800.0 | 179,847 | 614.0 | 138,033 | 680.0 | 152,870 |
| 32 | | 415.0 | 0.6433 | 3.90 | 2.62 | 735.0 | 165,235 | 813.0 | 182,770 | 623.0 | 140,056 | 690.0 | 155,118 |
| 34 | | 468.0 | 0.7254 | 4.40 | 2.96 | 828.0 | 186,142 | 917.0 | 206,150 | 704.0 | 158,265 | 779.0 | 175,126 |
| | 1 3/8 | 494.0 | 0.7657 | 4.60 | 3.09 | 874.0 | 196,483 | 968.0 | 217,615 | 743.0 | 167,033 | 823.0 | 185,018 |
| 36 | | 525.0 | 0.8138 | 4.90 | 3.29 | 929.0 | 208,847 | 1,029.0 | 231,328 | 789.0 | 177,374 | 874.0 | 196,483 |
| 38 | 1 1/2 | 585.0 | 0.9068 | 5.40 | 3.63 | 1,035.0 | 232,677 | 1,147.0 | 257,856 | 879.0 | 197,607 | 974.0 | 218,964 |
| 40 | | 648.0 | 1.0044 | 6.00 | 4.03 | 1,147.0 | 257,856 | 1,270.0 | 285,507 | 974.0 | 218,964 | 1,080.0 | 242,794 |
| | 1 5/8 | 690.0 | 1.0695 | 6.40 | 4.30 | 1,221.0 | 274,492 | 1,352.0 | 303,942 | 1,040.0 | 233,801 | 1,150.0 | 258,530 |
| 42 | | 714.0 | 1.1067 | 6.70 | 4.50 | 1,264.0 | 284,158 | 1,399.0 | 314,508 | 1,070.0 | 240,546 | 1,190.0 | 267,523 |
| 44 | | 784.0 | 1.2152 | 7.30 | 4.91 | 1,388.0 | 312,035 | 1,537.0 | 345,531 | 1,180.0 | 265,275 | 1,310.0 | 294,500 |
| | 1 3/4 | 800.0 | 1.2400 | 7.50 | 5.04 | 1,416.0 | 318,329 | 1,568.0 | 352,500 | 1,200.0 | 269,771 | 1,330.0 | 298,996 |
| 46 | | 857.0 | 1.3284 | 8.00 | 5.38 | 1,517.0 | 341,035 | 1,680.0 | 377,679 | 1,290.0 | 290,003 | 1,430.0 | 321,477 |
| | 1 7/8 | 919.0 | 1.4245 | 8.60 | 5.78 | 1,627.0 | 365,764 | 1,801.0 | 404,881 | 1,380.0 | 310,236 | 1,530.0 | 343,958 |
| 48 | | 933.0 | 1.4462 | 8.70 | 5.85 | 1,651.0 | 371,159 | 1,829.0 | 411,175 | 1,400.0 | 314,732 | 1,550.0 | 348,454 |
| 50 | | 1,013.0 | 1.5702 | 9.40 | 6.32 | 1,793.0 | 403,082 | 1,985.0 | 446,246 | 1,520.0 | 341,710 | 1,690.0 | 379,927 |
| | 2 | 1,045.0 | 1.6198 | 9.70 | 6.52 | 1,850.0 | 415,896 | 2,048.0 | 460,409 | 1,570.0 | 352,950 | 1,740.0 | 391,167 |
| 52 | | 1,095.0 | 1.6973 | 10.20 | 6.85 | 1,938.0 | 435,680 | 2,146.0 | 482,440 | 1,650.0 | 370,935 | 1,820.0 | 409,152 |
| 54 | 2 1/8 | 1,181.0 | 1.8306 | 11.00 | 7.39 | 2,090.0 | 469,851 | 2,315.0 | 520,433 | 1,780.0 | 400,160 | 1,970.0 | 442,874 |
| 56 | | 1,270.0 | 1.9685 | 11.80 | 7.93 | 2,248.0 | 505,370 | 2,489.0 | 559,549 | 1,910.0 | 429,385 | 2,110.0 | 474,347 |
| | 2 1/4 | 1,323.0 | 2.0507 | 12.30 | 8.27 | 2,342.0 | 526,502 | 2,593.0 | 582,929 | 1,990.0 | 447,370 | 2,200.0 | 494,580 |
| 58 | | 1,362.0 | 2.1111 | 12.70 | 8.53 | 2,411.0 | 542,014 | 2,670.0 | 600,240 | 2,050.0 | 460,858 | 2,270.0 | 510,316 |
| 60 | | 1,458.0 | 2.2599 | 13.60 | 9.14 | 2,581.0 | 580,232 | 2,858.0 | 642,504 | 2,190.0 | 492,331 | 2,430.0 | 546,286 |
| | 2 3/8 | 1,474.0 | 2.2847 | 13.70 | 9.21 | 2,609.0 | 586,526 | 2,889.0 | 649,473 | 2,540.0 | 571,015 | 2,540.0 | 571,015 |
| 62 | | 1,557.0 | 2.4134 | 14.50 | 9.74 | 2,756.0 | 619,573 | 3,052.0 | 686,117 | 2,660.0 | 597,992 | 2,660.0 | 597,992 |
| | 2 1/2 | 1,633.0 | 2.5312 | 15.20 | 10.21 | 2,890.0 | 649,698 | 3,201.0 | 719,613 | 2,770.0 | 622,721 | 2,770.0 | 622,721 |
| 64 | | 1,659.0 | 2.5715 | 15.50 | 10.42 | 2,936.0 | 660,039 | 3,252.0 | 731,079 | 2,810.0 | 631,713 | 2,810.0 | 631,713 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

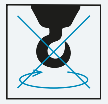
Special constructions and diameters available – please contact us directly.

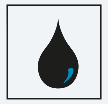
# CASAR **6X36 COMPACTED**

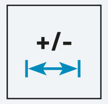


- Proven and reliable rope construction
- According to EN12385-6
- Available in galvanized and bright
- Available in ordinary (regular) lay or langs lay
- Available with either fiber core or IWRC
- Fully lubricated

## PROPERTIES


No swivel


Lubricated



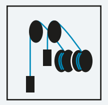
Tolerance

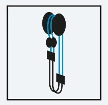
Compacted


preformed

## APPLICATIONS

The compacted 6x36 standard rope design is a proven and reliable rope with a wide range of applications.


Drum Winder


Koepe Winder head rope

| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force | | | | Minimum Breaking Force | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1770 N/mm² | | 1960 N/mm² | | 1770 N/mm² | | 1960 N/mm² | |
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 181.0 | 0.2806 | 1.70 | 1.14 | 320.0 | 71,939 | 355.0 | 79,807 | 264.0 | 59,350 | 292.0 | 65,644 |
| 22 | | 219.0 | 0.3395 | 2.10 | 1.41 | 388.0 | 87,226 | 429.0 | 96,443 | 320.0 | 71,939 | 354.0 | 79,582 |
| | 7/8 | 224.0 | 0.3472 | 2.10 | 1.41 | 396.0 | 89,024 | 439.0 | 98,691 | 326.0 | 73,288 | 361.0 | 81,156 |
| 24 | | 261.0 | 0.4046 | 2.40 | 1.61 | 462.0 | 103,862 | 512.0 | 115,102 | 380.0 | 85,427 | 421.0 | 94,645 |
| 25 | | 283.0 | 0.4387 | 2.70 | 1.81 | 501.0 | 112,629 | 555.0 | 124,769 | 413.0 | 92,846 | 457.0 | 102,738 |
| | 1 | 292.0 | 0.4526 | 2.70 | 1.81 | 517.0 | 116,226 | 572.0 | 128,591 | 426.0 | 95,769 | 472.0 | 106,110 |
| 26 | | 306.0 | 0.4743 | 2.90 | 1.95 | 542.0 | 121,846 | 600.0 | 134,885 | 446.0 | 100,265 | 494.0 | 111,056 |
| 28 | | 355.0 | 0.5503 | 3.30 | 2.22 | 628.0 | 141,180 | 696.0 | 156,467 | 518.0 | 116,451 | 573.0 | 128,815 |
| | 1 1/8 | 370.0 | 0.5735 | 3.50 | 2.35 | 655.0 | 147,250 | 725.0 | 162,986 | 539.0 | 121,172 | 597.0 | 134,211 |
| 30 | | 408.0 | 0.6324 | 3.80 | 2.55 | 722.0 | 162,312 | 800.0 | 179,847 | 594.0 | 133,536 | 658.0 | 147,924 |
| | 1 1/4 | 457.0 | 0.7084 | 4.30 | 2.89 | 809.0 | 181,870 | 896.0 | 201,429 | 666.0 | 149,723 | 737.0 | 165,684 |
| 32 | | 464.0 | 0.7192 | 4.40 | 2.96 | 821.0 | 184,568 | 909.0 | 204,351 | 676.0 | 151,971 | 749.0 | 168,382 |
| 34 | | 524.0 | 0.8122 | 4.90 | 3.29 | 927.0 | 208,398 | 1,027.0 | 230,879 | 763.0 | 171,529 | 845.0 | 189,964 |
| | 1 3/8 | 553.0 | 0.8572 | 5.20 | 3.49 | 979.0 | 220,088 | 1,084.0 | 243,693 | 806.0 | 181,196 | 892.0 | 200,530 |
| 36 | | 587.0 | 0.9099 | 5.50 | 3.70 | 1,039.0 | 233,576 | 1,151.0 | 258,755 | 856.0 | 192,436 | 947.0 | 212,894 |
| 38 | 1 1/2 | 654.0 | 1.0137 | 6.10 | 4.10 | 1,158.0 | 260,329 | 1,282.0 | 288,205 | 953.0 | 214,243 | 1,060.0 | 238,297 |
| 40 | | 725.0 | 1.1238 | 6.80 | 4.57 | 1,283.0 | 288,430 | 1,421.0 | 319,453 | 1,060.0 | 238,297 | 1,170.0 | 263,026 |
| | 1 5/8 | 772.0 | 1.1966 | 7.20 | 4.84 | 1,366.0 | 307,089 | 1,513.0 | 340,136 | 1,130.0 | 254,034 | 1,250.0 | 281,011 |
| 42 | | 799.0 | 1.2385 | 7.50 | 5.04 | 1,414.0 | 317,880 | 1,566.0 | 352,051 | 1,160.0 | 260,778 | 1,290.0 | 290,003 |
| 44 | | 877.0 | 1.3594 | 8.20 | 5.51 | 1,552.0 | 348,903 | 1,719.0 | 386,446 | 1,280.0 | 287,755 | 1,420.0 | 319,229 |
| | 1 3/4 | 895.0 | 1.3873 | 8.40 | 5.64 | 1,584.0 | 356,097 | 1,754.0 | 394,315 | 1,300.0 | 292,252 | 1,440.0 | 323,725 |
| 46 | | 959.0 | 1.4865 | 9.00 | 6.05 | 1,697.0 | 381,501 | 1,880.0 | 422,641 | 1,400.0 | 314,732 | 1,550.0 | 348,454 |
| | 1 7/8 | 1028.0 | 1.5934 | 9.60 | 6.45 | 1,820.0 | 409,152 | 2,015.0 | 452,990 | 1,500.0 | 337,213 | 1,660.0 | 373,183 |
| 48 | | 1044.0 | 1.6182 | 9.80 | 6.59 | 1,848.0 | 415,447 | 2,046.0 | 459,959 | 1,520.0 | 341,710 | 1,680.0 | 377,679 |
| 50 | | 1133.0 | 1.7562 | 10.60 | 7.12 | 2,005.0 | 450,742 | 2,221.0 | 499,301 | 1,650.0 | 370,935 | 1,830.0 | 411,400 |
| | 2 | 1169.0 | 1.8120 | 11.00 | 7.39 | 2,069.0 | 465,130 | 2,291.0 | 515,037 | 1,700.0 | 382,175 | 1,890.0 | 424,889 |
| 52 | | 1225.0 | 1.8988 | 11.50 | 7.73 | 2,168.0 | 487,386 | 2,401.0 | 539,766 | 1,790.0 | 402,408 | 1,980.0 | 445,122 |
| 54 | 2 1/8 | 1321.0 | 2.0476 | 12.40 | 8.33 | 2,338.0 | 525,603 | 2,589.0 | 582,030 | 1,930.0 | 433,881 | 2,130.0 | 478,843 |
| 56 | | 1421.0 | 2.2026 | 13.30 | 8.94 | 2,515.0 | 565,394 | 2,785.0 | 626,093 | 2,070.0 | 465,354 | 2,290.0 | 514,812 |
| | 2 1/4 | 1480.0 | 2.2940 | 13.90 | 9.34 | 2,620.0 | 588,999 | 2,901.0 | 652,171 | 2,160.0 | 485,587 | 2,390.0 | 537,293 |
| 58 | | 1524.0 | 2.3622 | 14.30 | 9.61 | 2,697.0 | 606,310 | 2,987.0 | 671,504 | 2,220.0 | 499,076 | 2,460.0 | 553,030 |
| 60 | | 1631.0 | 2.5281 | 15.30 | 10.28 | 2,887.0 | 649,023 | 3,197.0 | 718,714 | 2,380.0 | 535,045 | 2,630.0 | 591,247 |

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Special constructions and diameters available – please contact us directly.

# NEW RECORD ON CASAR MINING ROPES IN SLOVAKIA

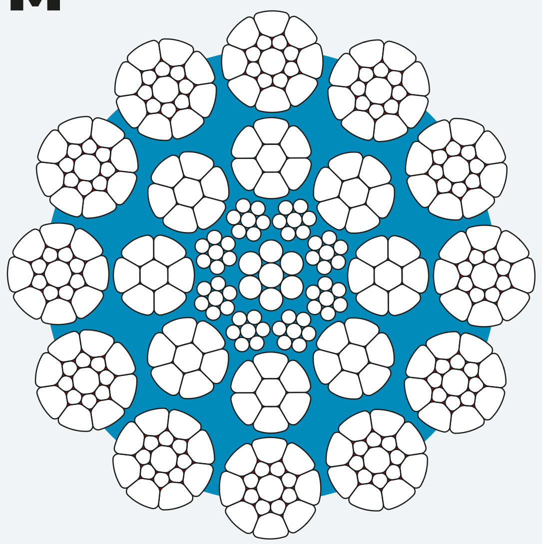
**Productivity is key for mining operations and reliable and performing hoist ropes play a most important role in this. A mine in Slovakia has succeeded in breaking records.**

In the Slovakian mining region of Horna Nitra, the company HBP, operates a total of 3 pits near the city of Prievidza. With an annual output of 1.9 million tons and over 100 years' experience, HBP is the largest brown coal producer in Slovakia.

The mine succeeded in achieving a cycle count of 656,000 and a total output of 12 million ton of moved rocks on the floor-based friction winch. On that mine there are 2 shafts, the North Shaft with a drum winch and a Ø40mm Turbo-plast M, and the South Shaft with the Ø66mm Turboplast M on a friction winch. The record-breaking rope is the Ø66mm Turboplast M with an operating length of 570m. The friction winch here reaches speeds of 12m/s and a load capacity of 7t. The installed rope has a lifetime of over 10 years with rope still on the system and will therefore push the record even higher. The mine has kept detailed records on the lifetimes of all ropes installed since 1976. The current rope is the thirteenth so far, and it has exceeded the life-times of all its predecessors by a factor of at least 2. Its safety is guaranteed through a magneto-inductive test, which takes place every six months. It is expected that the rope will remain on the system for some time yet – an even higher bar for future records! This is all the more remark-able because the rope has never been lubricated since its installation. The shaft is a dry shaft, however.

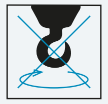
# 2 TIMES LONGER SERVICE LIFE, STILL PUSHING EVEN FURTHER

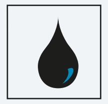
# CASAR DOUZEPLAST VM

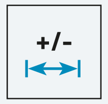


- High performance mining rope
- Koepe Tail / Balance Rope
- Designed to have a specific unit weight
- Rotation resistant
- Fully lubricated
- Plastic layer between steel core and outer strands
- Available in ordinary (regular) lay or langs lay
- Available with conventional or with compacted strands

## PROPERTIES

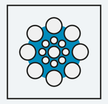

No swivel


Lubricated



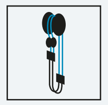
Tolerance

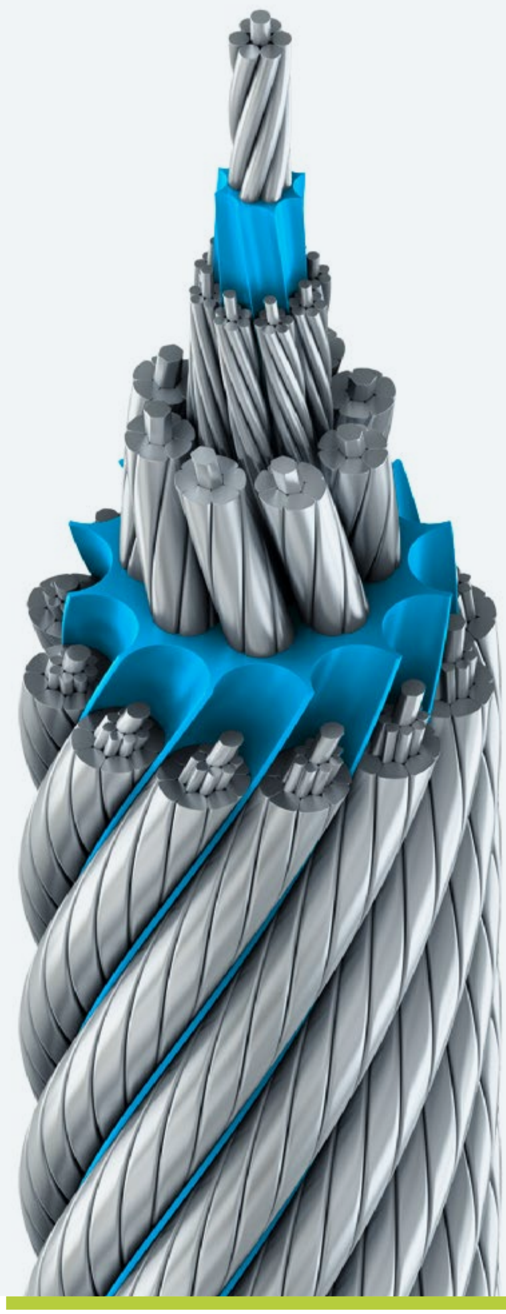
Compacted


Plast rope

## APPLICATIONS

High performance balance (tail) rope for koepe friction winder applications, where rotation-resistant ropes are required. Rope design and manufacturing parameters are adjusted according to the application, i.e. Douzeplast MT and Douzeplast VMT. The Douzeplast VM is a very flexible rope design, providing an excellent resistance to fatigue and corrosion.


Koepe Winder head rope



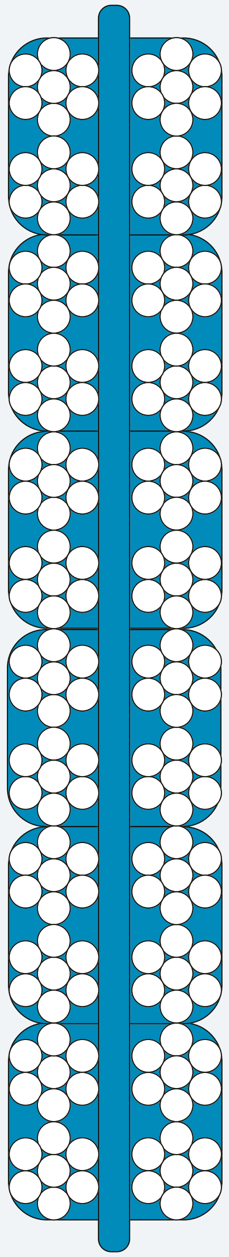
| Nominal Diameter | | metallic area | | Weight | | Aggregate Breaking Force | | | | Minimum Breaking Force | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1770 N/mm² | | 1960 N/mm² | | 1770 N/mm² | | 1960 N/mm² | |
| mm | inch | mm² | Sqin | kg/m | lb/ft | kN | lbs | kN | lbs | kN | lbs | kN | lbs |
| 20 | | 206.7 | 0.3204 | 1.81 | 1.22 | 324.5 | 72,955 | 365.9 | 82,248 | 276.2 | 62,085 | 303.7 | 68,274 |
| 21 | | 222.4 | 0.3447 | 1.95 | 1.31 | 349.1 | 78,483 | 393.6 | 88,481 | 297.1 | 66,789 | 334.8 | 75,266 |
| 22 | | 244.0 | 0.3783 | 2.14 | 1.44 | 383.2 | 86,136 | 432.0 | 97,108 | 326.1 | 73,302 | 367.5 | 82,617 |
| | 7/8 | 249.1 | 0.3860 | 2.18 | 1.47 | 391.0 | 87,907 | 440.8 | 99,105 | 332.8 | 74,809 | 375.1 | 84,316 |
| 23 | | 266.7 | 0.4134 | 2.34 | 1.57 | 418.8 | 94,144 | 472.1 | 106,137 | 356.4 | 80,117 | 401.6 | 90,283 |
| 24 | | 290.4 | 0.4502 | 2.55 | 1.71 | 456.0 | 102,509 | 514.1 | 115,567 | 388.0 | 87,235 | 437.3 | 98,309 |
| 25 | | 315.1 | 0.4885 | 2.76 | 1.86 | 494.8 | 111,229 | 557.8 | 125,398 | 421.1 | 94,656 | 474.5 | 106,672 |
| | 1 | 325.3 | 0.5042 | 2.85 | 1.92 | 510.7 | 114,817 | 575.8 | 129,443 | 434.6 | 97,709 | 489.8 | 110,113 |
| 26 | | 340.9 | 0.5283 | 2.99 | 2.01 | 535.1 | 120,305 | 603.3 | 135,631 | 455.4 | 102,380 | 513.2 | 115,372 |
| 27 | | 367.6 | 0.5697 | 3.22 | 2.17 | 577.1 | 129,738 | 650.6 | 146,265 | 491.1 | 110,407 | 553.5 | 124,432 |
| 28 | | 395.3 | 0.6127 | 3.47 | 2.33 | 620.6 | 139,526 | 699.7 | 157,300 | 528.2 | 118,736 | 595.2 | 133,806 |
| | 1 1/8 | 411.7 | 0.6382 | 3.61 | 2.43 | 646.4 | 145,315 | 728.7 | 163,827 | 550.1 | 123,663 | 619.9 | 139,358 |
| 29 | | 424.1 | 0.6573 | 3.72 | 2.50 | 665.8 | 149,670 | 750.6 | 168,736 | 566.6 | 127,369 | 638.5 | 143,540 |
| 30 | | 453.8 | 0.7034 | 3.98 | 2.67 | 712.5 | 160,170 | 803.2 | 180,574 | 606.3 | 136,304 | 683.3 | 153,612 |
| 31 | | 484.6 | 0.7511 | 4.25 | 2.86 | 760.8 | 171,026 | 857.7 | 192,812 | 647.4 | 145,543 | 729.6 | 164,021 |
| | 1 1/4 | 508.3 | 0.7879 | 4.46 | 3.00 | 798.0 | 179,401 | 899.7 | 202,255 | 679.1 | 152,670 | 765.3 | 172,053 |
| 32 | | 516.3 | 0.8003 | 4.53 | 3.04 | 810.6 | 182,238 | 913.9 | 205,453 | 689.8 | 155,084 | 777.4 | 174,766 |
| 33 | | 549.1 | 0.8511 | 4.82 | 3.24 | 862.1 | 193,805 | 971.9 | 218,494 | 733.6 | 164,928 | 826.8 | 185,872 |
| 34 | | 582.9 | 0.9035 | 5.11 | 3.44 | 915.1 | 205,729 | 1,031.7 | 231,937 | 778.8 | 175,076 | 877.7 | 197,315 |
| 35 | 1 3/8 | 615.0 | 0.9533 | 5.39 | 3.62 | 965.6 | 217,076 | 1,088.6 | 244,728 | 821.7 | 184,731 | 930.0 | 209,072 |
| 36 | | 653.5 | 1.0129 | 5.73 | 3.85 | 1,026.0 | 230,644 | 1,156.7 | 260,026 | 873.1 | 196,278 | 983.9 | 221,189 |
| 37 | | 690.3 | 1.0699 | 6.05 | 4.07 | 1,083.7 | 243,636 | 1,221.8 | 274,672 | 922.3 | 207,334 | 1,039.4 | 233,666 |
| 38 | 1 1/2 | 731.9 | 1.1345 | 6.42 | 4.31 | 1,149.1 | 258,338 | 1,295.5 | 291,247 | 977.9 | 219,845 | 1,096.3 | 246,458 |
| 39 | | 766.9 | 1.1887 | 6.73 | 4.52 | 1,204.1 | 270,687 | 1,357.5 | 305,169 | 1,024.7 | 230,355 | 1,154.8 | 259,609 |
| 40 | | 806.8 | 1.2505 | 7.08 | 4.75 | 1,266.6 | 284,746 | 1,428.0 | 321,020 | 1,077.9 | 242,319 | 1,214.8 | 273,098 |
| 41 | | 847.6 | 1.3138 | 7.43 | 5.00 | 1,330.7 | 299,162 | 1,500.3 | 337,271 | 1,132.5 | 254,586 | 1,276.2 | 286,901 |
| | 1 5/8 | 859.0 | 1.3315 | 7.53 | 5.06 | 1,348.6 | 303,188 | 1,520.5 | 341,811 | 1,147.7 | 258,013 | 1,293.4 | 290,763 |
| 42 | | 889.5 | 1.3787 | 7.80 | 5.24 | 1,396.4 | 313,933 | 1,574.3 | 353,924 | 1,188.4 | 267,157 | 1,371.0 | 308,213 |
| 43 | | 932.3 | 1.4451 | 8.18 | 5.49 | 1,463.7 | 329,060 | 1,650.2 | 370,978 | 1,245.6 | 280,030 | 1,403.8 | 315,587 |
| 44 | | 976.2 | 1.5131 | 8.56 | 5.75 | 1,532.6 | 344,543 | 1,727.8 | 388,434 | 1,304.2 | 293,206 | 1,469.8 | 330,424 |
| | 1 3/4 | 996.3 | 1.5442 | 8.74 | 5.87 | 1,564.1 | 351,626 | 1,763.4 | 396,420 | 1,331.1 | 299,234 | 1,500.0 | 337,217 |
| 45 | | 1,021.1 | 1.5826 | 8.95 | 6.02 | 1,603.1 | 360,382 | 1,807.3 | 406,291 | 1,364.2 | 306,685 | 1,537.4 | 345,621 |
| 46 | | 1,066.9 | 1.6538 | 9.36 | 6.29 | 1,675.1 | 376,577 | 1,888.5 | 424,549 | 1,425.5 | 320,467 | 1,606.5 | 361,155 |
| | 1 7/8 | 1,143.7 | 1.7727 | 10.03 | 6.74 | 1,795.5 | 403,653 | 2,024.3 | 455,074 | 1,528.0 | 343,509 | 1,722.0 | 387,123 |
| 47 | | 1,113.8 | 1.7264 | 9.77 | 6.56 | 1,748.7 | 393,128 | 1,971.5 | 443,208 | 1,488.2 | 334,552 | 1,677.1 | 377,027 |
| 48 | | 1,161.7 | 1.8007 | 10.19 | 6.85 | 1,823.9 | 410,035 | 2,056.3 | 462,268 | 1,552.2 | 348,939 | 1,749.2 | 393,236 |
| 49 | | 1,210.6 | 1.8765 | 10.62 | 7.13 | 1,900.7 | 427,297 | 2,142.8 | 481,730 | 1,617.5 | 363,630 | 1,822.9 | 409,804 |
| 50 | | 1,260.6 | 1.9539 | 11.06 | 7.43 | 1,979.1 | 444,916 | 2,231.2 | 501,593 | 1,684.2 | 378,624 | 1,898.0 | 426,687 |
| | 2 | 1,301.2 | 2.0169 | 11.41 | 7.67 | 2,042.9 | 459,267 | 2,303.2 | 517,773 | 1,738.5 | 390,836 | 1,959.2 | 440,451 |
| 51 | | 1,311.5 | 2.0328 | 11.50 | 7.73 | 2,059.0 | 462,891 | 2,321.3 | 521,858 | 1,752.2 | 393,920 | 1,974.7 | 443,930 |
| 52 | | 1,363.4 | 2.1133 | 11.96 | 8.03 | 2,140.6 | 481,221 | 2,413.3 | 542,523 | 1,821.6 | 409,519 | 2,052.9 | 461,510 |
| 53 | | 1,416.4 | 2.1954 | 12.42 | 8.35 | 2,223.7 | 499,908 | 2,507.0 | 563,590 | 1,892.4 | 425,421 | 2,132.6 | 479,427 |
| 54 | 2 1/8 | 1,469.0 | 2.2769 | 12.88 | 8.66 | 2,306.3 | 518,470 | 2,600.1 | 584,517 | 1,962.6 | 441,218 | 2,213.9 | 497,704 |
| 55 | | 1,525.3 | 2.3642 | 13.38 | 8.99 | 2,394.7 | 538,348 | 2,699.8 | 606,928 | 2,037.9 | 458,135 | 2,296.6 | 516,296 |
| 56 | | 1,581.3 | 2.4509 | 13.87 | 9.32 | 2,482.6 | 558,103 | 2,798.8 | 629,199 | 2,112.7 | 474,945 | 2,380.9 | 535,248 |
| 57 | | 1,638.2 | 2.5393 | 14.37 | 9.65 | 2,572.0 | 578,213 | 2,899.7 | 651,871 | 2,188.8 | 492,059 | 2,466.7 | 554,536 |
| | 2 1/4 | 1,646.9 | 2.5526 | 14.44 | 9.71 | 2,585.6 | 581,260 | 2,914.9 | 655,306 | 2,200.3 | 494,652 | 2,479.7 | 557,459 |
| 58 | | 1,696.2 | 2.6291 | 14.88 | 10.00 | 2,663.1 | 598,679 | 3,002.3 | 674,944 | 2,266.3 | 509,476 | 2,554.0 | 574,162 |
| 59 | | 1,755.2 | 2.7206 | 15.39 | 10.34 | 2,755.7 | 619,501 | 3,106.7 | 698,418 | 2,345.1 | 527,195 | 2,642.8 | 594,125 |
| 60 | | 1,815.2 | 2.8136 | 15.92 | 10.70 | 2,849.9 | 640,679 | 3,212.9 | 722,294 | 2,425.3 | 545,218 | 2,733.2 | 614,448 |
| | 2 3/8 | 1,834.9 | 2.8441 | 16.09 | 10.81 | 2,880.8 | 647,639 | 3,247.8 | 730,140 | 2,451.6 | 551,140 | 2,762.9 | 621,122 |
| 61 | | 1,876.2 | 2.9081 | 16.45 | 11.06 | 2,945.7 | 662,213 | 3,320.9 | 746,571 | 2,506.8 | 563,543 | 2,825.1 | 635,108 |
| 62 | | 1,938.2 | 3.0043 | 17.00 | 11.42 | 3,043.0 | 684,103 | 3,430.7 | 771,250 | 2,589.6 | 582,172 | 2,918.4 | 656,082 |
| 63 | | 2,001.3 | 3.1020 | 17.55 | 11.79 | 3,142.0 | 706,349 | 3,542.3 | 796,329 | 2,673.8 | 601,103 | 3,013.3 | 677,417 |
| | 2 1/2 | 2,033.2 | 3.1514 | 17.83 | 11.98 | 3,192.1 | 717,605 | 3,598.7 | 809,020 | 2,716.4 | 610,682 | 3,061.3 | 688,212 |
| 64 | | 2,065.3 | 3.2012 | 18.11 | 12.17 | 3,242.5 | 728,950 | 3,655.6 | 821,810 | 2,759.4 | 620,337 | 3,109.8 | 699,111 |
| 65 | | 2,130.4 | 3.3020 | 18.68 | 12.55 | 3,344.7 | 751,908 | 3,770.7 | 847,693 | 2,846.3 | 639,874 | 3,207.7 | 721,120 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

Special constructions and diameters available – please contact us directly.

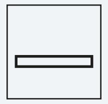
# CASAR **FLAT BALANCE ROPE**

- Koepe Tail / Balance Rope
- Conventional strands
- Designed to have a specific unit weight
- Very flexible
- Very small loop diameter
- Single or double stitched
- Riveted
- Conforms to EN12385-6



## PROPERTIES

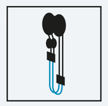
No swivel · Lubricated · Tolerance



Flat rope

## APPLICATIONS

Our proven and reliable flat rope is perfectly designed to operate as a balance (tail) rope on a koepe friction winder application. It is made according to the EN12385 standard at the most modern manufacturing line wordwide. Due to its flat shape, very small balance rope loop diameters are possible to fit into small shaft compartments.



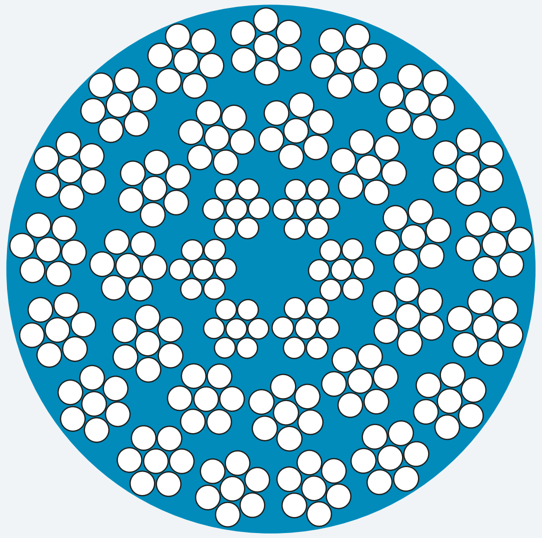
Koepe Winder balance rope

| Nominal values width w x thickness s mm | | Nominal diameter of load-bearing wires | Sum of nominal cross sectional area of load-bearing wires | Nominal rope length mass of lubricated rope | | | Minimum Aggregate Breaking Force $f_{e.min}$ Rope Grade | |
|---|---|---|---|---|---|---|---|---|
| double stitched | single stitched or riveted | | | double stitched | single stitched | riveted/ clamped | 1370 | 1570 |
| mm | mm | mm | mm² | kg/100 m | kg/100 m | kg/100 m | kN | kN |
| **Rope class: 6 x 4 x 7 = 6 unit ropes each of 4 strands each of 1+6 wires = 168 wires** | | | | | | | | |
| 70x17 | 70x15 | 1.6 | 338 | 342 | 328 | 322 | 463 | 531 |
| 74x18 | 74x16 | 1.7 | 381 | 385 | 370 | 362 | 522 | 598 |
| 78x19 | 78x17 | 1.8 | 428 | 433 | 416 | 407 | 586 | 672 |
| 82x20 | 82x18 | 1.9 | 476 | 481 | 462 | 453 | 652 | 747 |
| 87x21 | 87x19 | 2.0 | 526 | 534 | 513 | 502 | 723 | 829 |
| 91x22 | 91x20 | 2.1 | 582 | 588 | 565 | 553 | 797 | 914 |
| 95x23 | 95x21 | 2.2 | 639 | 646 | 620 | 607 | 875 | 1003 |
| **Rope class: 8 x 4 x 7 = 8 unit ropes each of 4 strands each of 1+6 wires = 224 wires** | | | | | | | | |
| 110x20 | 110x18 | 1.9 | 635 | 642 | 616 | 604 | 870 | 997 |
| 113x20 | 113x18 | 1.95 | 669 | 676 | 649 | 636 | 917 | 1050 |
| 116x21 | 116x19 | 2.0 | 704 | 711 | 683 | 669 | 964 | 1105 |
| 119x21 | 119x19 | 2.05 | 739 | 747 | 717 | 702 | 1010 | 1160 |
| 122x22 | 122x20 | 2.1 | 776 | 784 | 753 | 738 | 1060 | 1220 |
| 125x22 | 125x20 | 2.15 | 813 | 822 | 789 | 773 | 1110 | 1280 |
| 128x23 | 128x21 | 2.2 | 851 | 860 | 826 | 809 | 1170 | 1340 |
| **Rope class: 6 x 4 x 12 = 6 unit ropes each of 4 strands each of 3+9 wires = 288 wires** | | | | | | | | |
| 112x26 | 112x23 | 1.9 | 817 | 826 | 793 | 768 | 1120 | 1280 |
| 115x26 | 115x23 | 1.95 | 860 | 869 | 835 | 809 | 1180 | 1350 |
| 118x27 | 118x24 | 2.0 | 905 | 914 | 878 | 851 | 1240 | 1420 |
| 121x27 | 121x24 | 2.05 | 951 | 961 | 923 | 894 | 1300 | 1490 |
| 124x28 | 124x25 | 2.1 | 998 | 1010 | 968 | 939 | 1370 | 1570 |
| 127x28 | 127x25 | 2.15 | 1046 | 1060 | 1020 | 984 | 1430 | 1640 |
| 130x29 | 130x26 | 2.2 | 1095 | 1110 | 1070 | 1030 | 1500 | 1720 |
| **Rope class: 8 x 4 x 12 M= 8 unit ropes each of 4 strands each of 3+9 wires = 384 wires** | | | | | | | | |
| 146x25 | 146x23 | 1.9 | 1089 | 1100 | 1060 | 1030 | 1490 | 1710 |
| 149x26 | 149x23 | 1.95 | 1147 | 1160 | 1120 | 1080 | 1570 | 1800 |
| 154x27 | 154x24 | 2.0 | 1206 | 1220 | 1170 | 1140 | 1650 | 1890 |
| 157x27 | 157x24 | 2.05 | 1267 | 1280 | 1230 | 1190 | 1740 | 1990 |
| 160x28 | 160x25 | 2.1 | 1330 | 1350 | 1290 | 1250 | 1820 | 2090 |
| 165x28 | 165x25 | 2.15 | 1394 | 1410 | 1360 | 1310 | 1910 | 2190 |
| 168x29 | 168x26 | 2.2 | 1460 | 1480 | 1420 | 1380 | 2000 | 2290 |
| **Rope class: 8 x 4 x 14 M= 8 unit ropes each of 4 strands each of 4+10 wires = 448 wires** | | | | | | | | |
| 168x28 | 168x25 | 2.0 | 1407 | 1430 | 1370 | 1330 | 1930 | 2210 |
| 172x29 | 172x26 | 2.05 | 1479 | 1500 | 1440 | 1390 | 2030 | 2320 |
| 176x29 | 176x26 | 2.1 | 1552 | 1570 | 1510 | 1460 | 2130 | 2440 |
| 180x30 | 180x27 | 2.15 | 1626 | 1650 | 1580 | 1530 | 2230 | 2550 |
| 184x30 | 184x27 | 2.2 | 1703 | 1720 | 1660 | 1600 | 2330 | 2670 |
| **Rope class: 8 x 4 x 19 M= 8 unit ropes each of 4 strands each of 1+6+12 wires = 608 wires** | | | | | | | | |
| 186x31 | 186x28 | 1.9 | 1724 | 1750 | 1680 | 1620 | 2360 | 2710 |
| 190x32 | 190x29 | 1.95 | 1816 | 1840 | 1780 | 1700 | 2490 | 2850 |
| 194x33 | 194x30 | 2.0 | 1910 | 1930 | 1860 | 1800 | 2620 | 3000 |
| 200x34 | 200x31 | 2.05 | 2007 | 2030 | 1950 | 1890 | 2750 | 3150 |
| 204x34 | 204x31 | 2.1 | 2106 | 2130 | 2040 | 1980 | 2890 | 3310 |
| 210x36 | 210x32 | 2.15 | 2207 | 2230 | 2140 | 2080 | 3020 | 3460 |
| 216x37 | 216x33 | 2.2 | 2311 | 2330 | 2240 | 2180 | 3170 | 3630 |

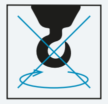
Values according to EN 12385-6:2004. Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

# CASAR **PLASTIC COVERED ROUND BALANCE ROPES**

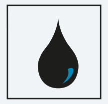
- Koepe Tail / Balance Rope
- Conventional strands
- Rotation resistant
- Designed to have a specific unit weight
- Impregnated and coated with tough polymer, offering superior protection against the harsh, aggressive environment of an underground mining shaft.
- Available in ordinary (regular) lay or langs lay



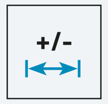
## PROPERTIES



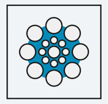
No swivel



Lubricated



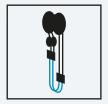

Tolerance



Plast rope

## APPLICATIONS

Our proven and reliable plastic impregnated and coated round rope is perfectly designed to operate as a balance (tail) rope on a koepe friction winder application. The tough polymer provides a superior protection against the harsh, aggressive environment of an underground mining shaft.



Koepe Winder balance rope

| Inner, nominal diameter | | Outer, nominal diameter | | Weight | | Minimum Breaking Force | |
|---|---|---|---|---|---|---|---|
| mm | inch | mm | inch | kg/m | lb/ft | kN | lbs |
| 30 | 1 3/16 | 37 | 1 7/16 | 3.65 | 2.45 | 467 | 105,000 |
| 32 | 1 1/4 | 38 | 1 1/2 | 4.84 | 3.25 | 512 | 115,000 |
| 33 | 1 5/16 | 40 | 1 9/16 | 5.13 | 3.45 | 534 | 120,000 |
| 35 | 1 3/8 | 41 | 1 5/8 | 5.71 | 3.84 | 649 | 146,000 |
| 37 | 1 7/16 | 43 | 1 11/16 | 6.10 | 4.10 | 734 | 165,000 |
| 40 | 1 9/16 | 46 | 1 13/16 | 7.10 | 4.77 | 823 | 185,000 |
| 41 | 1 5/8 | 48 | 1 7/8 | 7.89 | 5.30 | 912 | 205,000 |
| 43 | 1 11/16 | 49 | 1 15/16 | 8.14 | 5.47 | 979 | 220,000 |
| 44 | 1 3/4 | 51 | 2 | 8.75 | 5.88 | 1032 | 232,000 |
| 48 | 1 7/8 | 54 | 2 1/8 | 10.04 | 6.75 | 1192 | 268,000 |
| 51 | 2 | 57 | 2 1/4 | 11.43 | 7.68 | 1352 | 304,000 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

Special constructions and diameters available – please contact us directly.

# CASAR MINING ROPES IN CHINA

**In China, too, the productivity and safety of a mine has top priority. With high-performance ropes from Casar, unlimited possibilities open up for mining operators.**

Several years ago, CASAR's mining sales and technical group began seeking a partner in the Chinese coal industry to test CASAR's high performance mining ropes. After several visits and technical evaluations on their winding system, Huainan Mining Industry Group, one of the largest mining groups in China, agreed to test CASAR ropes.

In the mining industry, shutting down equipment for a few days to replace ropes is extremely costly. These maintenance breaks could take place every year which adversely affects the mine's profit.

It is a huge benefit to a mine to be able to run the machines longer between the rope's replacements. Huainan Mining's target was to reach a rope lifetime that enables the mine to extend the time between scheduled rope changes to two or probably three years. When CASAR first met with them they could not reach year two on the competitor's ropes so they often changed ropes after one year to avoid an unscheduled breakdown.

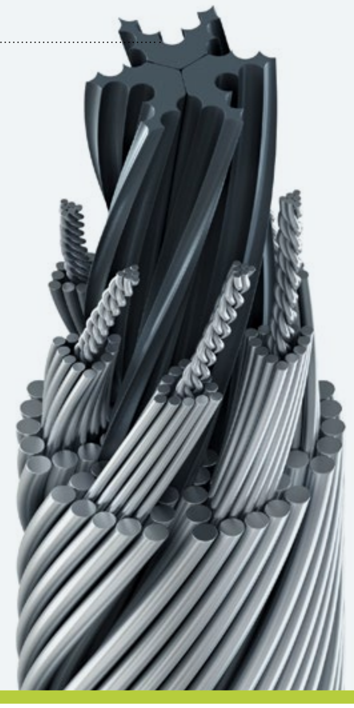
The high performance hoist rope CASAR Turboplast MF was installed on the 4-rope, ground-mounted friction winder system replacing some flattened strand mining ropes. These are the first CASAR Special Mining Ropes operating in China and the first mining ropes with a steel core operating in the Chinese coal mining industry.

The 56mm Turboplast MF was challenged at one of the most productive and heaviest duty coal mines in the country. Supplied for a field trial test, this CASAR rope not only achieved the targeted service life but also set a new mine record – off the cuff – in terms of rope service life and production capacity achieved for a given rope set. Huainan's mine transports more than 13 million tons of hard coal per annum. This makes the hoisting system one of the highest production capacity hoists not only in China but also worldwide.

**Turboplast MF Tonnage:**
8 Mill. Tons
**Turboplast MF scheduled rope changes:**
2 or probably 3 years

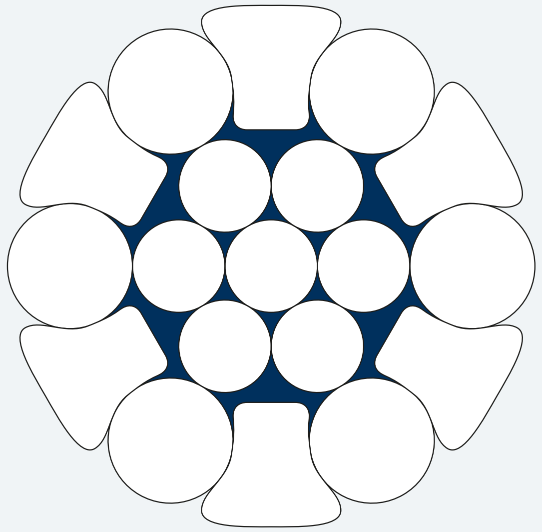
# 3 TIMES LONGER SERVICE LIFE SCHEDULED

**Competitor's ropes:**
changed every year

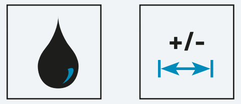


# CASAR HALF LOCK COIL ROPE

- Guide or rubbing rope
- Round and shaped wires
- Special design to increase wear and corrosion resistance
- Conforms to EN12385-7



## PROPERTIES




Lubricated Tolerance

## APPLICATIONS

Our half locked coil guide ropes according to EN12385-7 standard are available in various sizes and designs, but can be modified to meet the individual requirement. This rope design is used as guide or rubbing ropes for underground mining applications.

| Nominal Diameter | | Weight | | Aggregate Breaking Force | |
|---|---|---|---|---|---|
| mm | inch | kg/m | lb/ft | kN | lbs |
| 29 | | 4.6 | 3.09 | 455.4 | 102,378 |
| 32 | | 5.6 | 3.76 | 554.1 | 124,567 |
| 35 | | 6.7 | 4.50 | 663.4 | 149,139 |
| 38 | | 7.9 | 5.31 | 784.4 | 176,341 |
| 41 | | 9.3 | 6.25 | 909.7 | 204,510 |
| 45 | | 11.1 | 7.46 | 1093.3 | 245,785 |
| 48 | | 12.7 | 8.53 | 1241.9 | 279,192 |
| 51 | | 14.3 | 9.61 | 1411.7 | 317,364 |

Product specifications are subject to change without notice or obligation. The shown drawings or cross sections are only for illustrative purposes; the images can vary depending on requested diameter and current status of technical development. This table is for reference only. Additional sizes available upon request.

Special constructions and diameters available – please contact us directly.

# CASAR ROPES FULLY PROVE THEIR PERFORMANCE IN SIBERIAN MINE

**CASAR has now, for a number of years, been a supplier to the most important and biggest mining company in Russia, Norilsk Nickel. We started with two trial deliveries in 2016 and 2017. The first being the Taymyrsky mine (picture) where we installed the 43.5mm Starplast MF rope design with lengths of 1,650m each.**

This test trial was successfully completed in 2019. The Starplast MF increased the service life by 80% when compared to the hoisting rope previously used and supplied by a competitor. The rope was removed from service at the end of the trial period, without having deterioted to the extent that neccesitated discard. After the test trial of this set the deliveries of this type of ropes for the hoists of Norilsk Nickel have become regular.

Norilsk Nickel provided us with several test lengths of the Starplast MF for further analysis here at Kirkel. Nearing conclusion of these rope examinations, the Norilsk Nickel engineers and employees of the in-house test laboratory were invited to Kirkel. We shared with the visitors the test results that had already been completed and dismantled a test sample, wire by wire, in their presence. The inspection revealed a rope whose condition can be described as almost new, even though the test sample was selected from the most severe stressed zone on the rope. In the end, we were able to not only confirm the promised and expected rope service life, but also convinced the customer to use our product forthwith, due to the excellent condition of the rope after the period of service and, above all, the extra margin of safety and reserve strength towards the end of life.

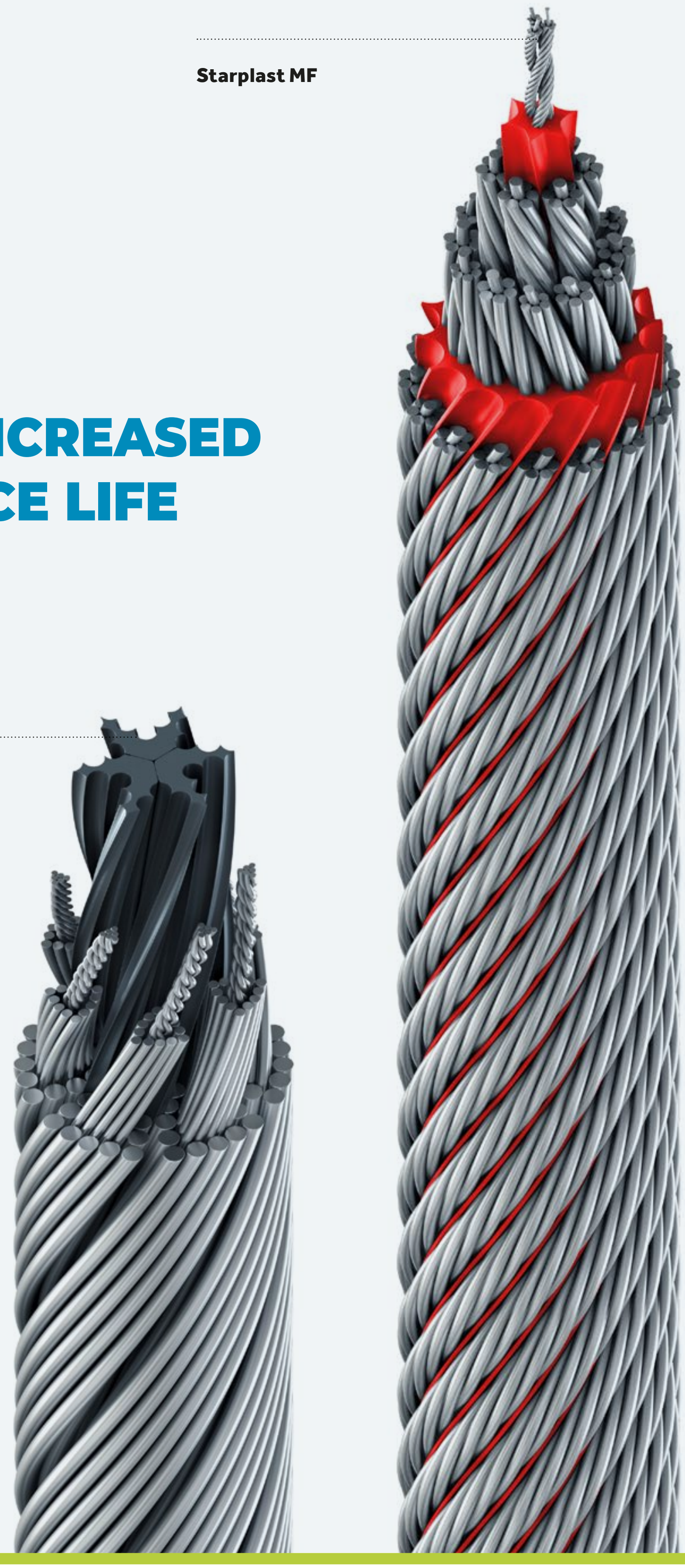
The trial phase of the second delivery was also successfully completed at the end of March 2021. In July 2017, Norilsk Nickel installed a set of 41.5mm Stratoplast MF in lengths of 850m each in the Komsomolskiy mine, also a Koepe hoist (Friction Winder).

After a period of three years and eight months and having hauled more than seven million tons, the Stratoplast MF was also able to complete the test phase with great success and was replaced by a new set of Stratoplast MF for normal winding operations.

In addition to the significant increase in service life, Norilsk Nickel was also impressed with the reduction in operating costs possible with our hoisting ropes, as less interventions were required due to rope elongation cuttings, exceeding rotation and cleaning the rope and hoist due to excessive lubrication.

Besides, CASAR has also been approved as a permanent supplier of flat ropes (as balance or tail ropes), manufactured by our Polish colleagues at Drumet, mostly by hand.

## 80% INCREASED SERVICE LIFE



# HIGH-PERFORMANCE MINING ROPES

Hoisting ropes in all mining operations play a safety-critical role in the production cycle, not only to hoist minerals but, also to transport employees and materials efficiently and safely.
CASAR specialises in this technology and is the global leader in the manufacture of sophisticated wire rope products, for a broad range of lifting applications. We believe we can offer value to the mine's business, through our innovative technology, manufacturing skills, and expertise.

## 1. THE HIGH-PERFORMANCE MINING ROPE

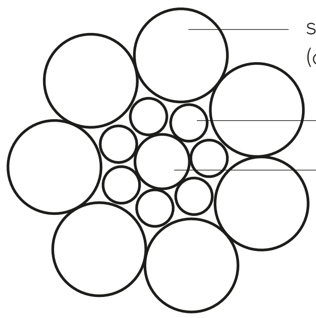
### The Wire Rod and Rope Wire

The majority of rope wires are made from well-defined carbon steel with contents of carbon and manganese up to 1%, phosphorus and sulphur up to 0.5% and silicon between 0.1% and 0.3%. The raw material for rope wires is wire rod of 6mm to 9mm diameters. This rod wire is processed to the required rope wire diameter and strength as well as wire shape. The cold forming drawing and rolling process is able to achieve for instance rope wire diameter tolerances of 0.01mm.
Most wire ropes are made with uncoated (bright) high-carbon steel wires. Galvanized wire is often used to improve the corrosion resistance of wire ropes. The following two types are used:
Galvanized-to-finished size wire starts as a smaller diameter bright wire and is then coated with a zinc layer that increases the diameter to the designed finished size. Galvanized-to-finished wires are 10% lower in strength than the same size and grade bright wire. Therefore, ropes made with these wires have minimum breaking forces that are 10% lower in strength when compared to their bright version.
Drawn galvanized wire is bright wire galvanized just before it being drawn down to its final finished diameter. This leaves a much thinner zinc coating than is on galvanized-to-finished wires. Drawn galvanized wires are equal in strength to the same size and grade of bright wire. Therefore, ropes made with these wires have minimum breaking forces that are equal to their bright versions.
Traditional wire rope corrosion protection relies on pure zinc applied to the surface of the wires. Using a zinc-aluminum alloy is a significantly improved process when compared to the traditional galvanizing process. Combining the passive corrosion inhibition of aluminum oxidation with the active and passive effects of zinc results in approximately three times the amount of corrosion protection compared to standard zinc coated wires. The coating also provides an anodic feature that heals over the exposed steel when the wire is abraded or scratched.

According to EN 10264, ungalvanised wires (often specified as bright wire or uncoated wire), are specified with the letter "U". Rope wires with a zinc coating are either specified with a letter "A" or a "B", depending on the coating mass. Additionally, there are rope wires with a Zn95/Al5 coating available.
Furthermore, where bright wires are replaced with galvanised wires for the inner wires and core wires, such a rope can still be classified as bright or ungalvanised. For a galvanised rope, all wires, including the core, need to be galvanised.
Besides the wire coating, there are different shapes of rope wires used. Round rope wires certainly have a round shape and all wires, which are made with a shaped cross-section (i.e. not round) are defined as profiled wires.
A further specification for rope wires is the tensile strength. The tensile strength is a fraction of the maximum axial force that can be applied to the wire before breaking and the cross sectional metal area of the wire. Usually, the rope wire is defined with a nominal tensile strength, which is confirmed by the actual tensile break test, where the actual strength may not undermatch the nominal strength. Nominal tensile strengths for mining rope wires are specified in several steps, between 1370 N/mm² and 2160 N/mm².
The choice of tensile strength of mine winder ropes primarily depends on the breaking load required. Mine winder ropes manufactured from wires with a 1770 N/mm² and 1960 N/mm² tensile grades, provide approximately the same level of useful service life, when operated under similar conditions. Mine winder ropes manufactured from wires with a tensile grade, greater than 1960 N/mm², should only be used if the breaking load required, cannot be achieved by any other means, such as selecting a rope design or size with a higher metallic area.
The hardness of the wires typically ranges between 500 to 650 HV.
The wires referred to as "Outer Wires" are positioned in the outer layer of wires in a spiral rope or the outer layer of wires in the outer strands of a stranded rope. A layer of wires is the assemblage of wires with the same pitch circle diameter. Filler wires (or fibers) are not considered and don't represent an individual layer.

### The Rope Strand

Wires are the basic building blocks of a wire rope. They lay around a "center" in a specified pattern in one or more layers to form a strand. The strands are helically laid together around a center, typically some type of core, to form a wire rope.




Properties like fatigue resistance and resistance to abrasion are directly affected by the design of strands. In most strands with two or more layers of wires, inner layers support outer layers in such a manner that all wires may slide and adjust freely when the rope bends.
As a general rule, a rope that has strands made up of a few large wires will be more abrasion resistant and less fatigue resistant than a rope of the same size made up of strands with many smaller wires.

**Round Strand**

Round strands are defined as strands with a circle shaped cross section and triangular strands are shaped approximately like a triangle.

**Single Layer**

The most common example of single-layer construction is a 7 wire strand. It has a single-wire center with six wires of the same diameter around it.

**Seale Construction**

This construction has two layers of wires around a center with the same number of wires in each layer. All wires in each layer are the same diameter. The strand is designed so that the large outer wires rest in the valleys between the smaller inner wires. Example: 19 Seale (1-9-9) strand.

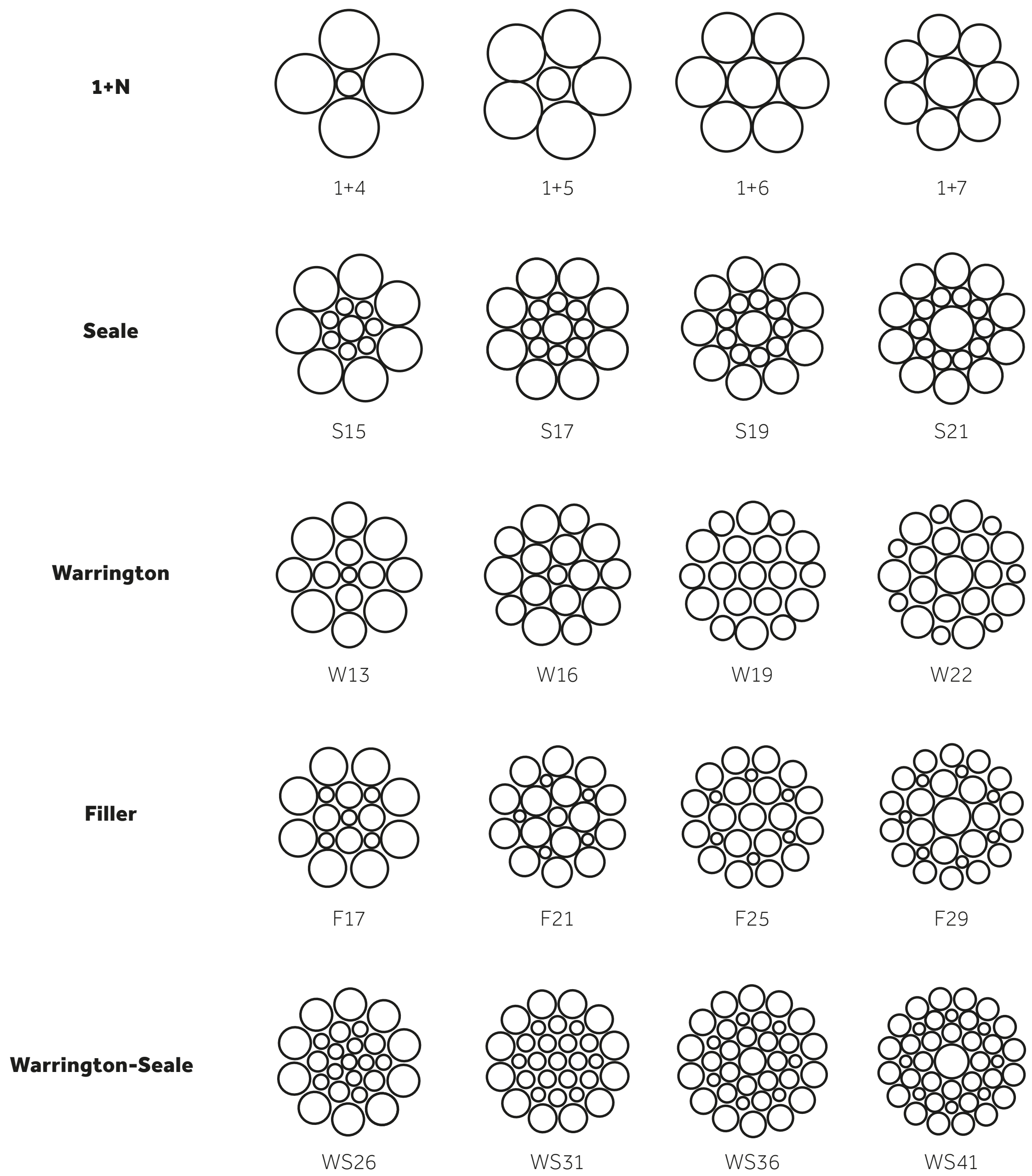
**Warrington Construction**

This construction has two layers of wires around a center with one diameter of wire in the inner layer, and two diameters of wire alternating large and small in the outer layer. The larger wires in the outer layer rest in the valleys, and the smaller ones on the crowns, of the inner layer. Example: 19 Warrington [1-6-(6+6)].

The majority of rope strands are one-, two- and three layer standard as well as parallel-lay designs. Standard designs are manufactured with wire crossovers within the wire layers of the strand. Parallel-lay strand designs, such as Filler, Seale, Warrington or Warrington-Seale, are manufactured with all wire layers stranded in one operation with the wire same lay lengths, and avoid wire crossovers with wires laid in line contacts.

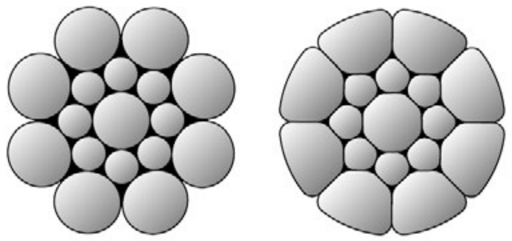
| construction type | symbol | examples of strand construction |
|---|---|---|
| **Single lay** | | |
| | No symbol | 6 i.e. (1-5) |
| | | 7 i.e. (1-6) |
| **Parallel lay** | | |
| Seale | S | 17S i.e. (1-8-8) |
| | | 19S i.e. (1-9-9) |
| Warrington | W | 19W i.e. (1-6-6+6) |
| Filler | F | 21F i.e. (1-5-5F-10) |
| | | 25F i.e. (1-6-6F-12) |
| | | 29F i.e. (1-7-7F-14) |
| | | 41F i.e. (1-8-8-8F-16) |
| **Combined parallel lay** | | |
| | WS | 26WS i.e. (1-5-5+5-10) |
| | | 31WS i.e. (1-6-6+6-12) |
| | | 36WS i.e. (1-7-7+7-14) |
| | | 41WS i.e. (1-8-8+8-16) |
| | | 41WS i.e. (1-6/8-8+8-16) |
| | | 46WS i.e. (1-9-9+9-18) |
| **Multiple operation lay (round strand)** | | |
| Cross lay | M | 19M i.e. (1-6/12) |
| Compound lay* | N | 37M i.e. (1-6/12/18) |
| | | 35NW i.e. (1-6-6+6/16) |

* N is additional and precedes the basic type symbol, e.g. Compound Seale is NS and Compound Warrington is NW



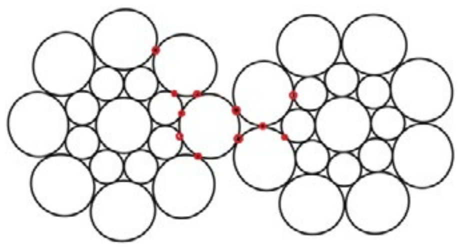
**Compacted Strand**

Casar Special Wire Ropes are made out of both conventional strands and compacted strands, determined by the application and rope properties required.
To produce a compacted strand, a conventional strand made out of round wires is drawn through a compacting tool. During this procedure, the wires are plastically deformed, the strand diameter is reduced and the surface is made smooth. The contact conditions between the individual wires and the strand-to-strand contacts improve.

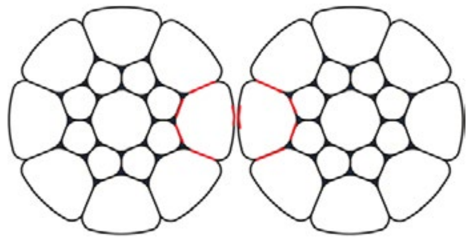


*conventional strand* *compacted strand*

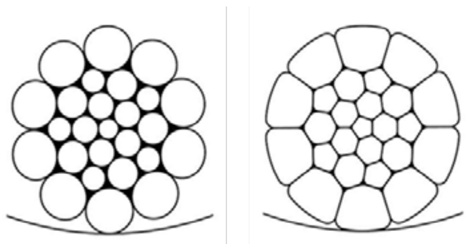
Ropes made out of compacted strands have a higher breaking load, greater flexibility and better rope-to-sheave contact conditions than comparable ropes made out of conventional strands. Because of the larger outer wires and the smaller exposed area they are more resistant to abrasion and corrosion.
With the compaction of rope strands, the metallic cross section of the strand is increased. Therefore, the compaction of rope strands increases the amount of steel within a certain space, which the strand represents in the wire rope designed cross section.



As per definition, the fill factor is the ratio of the sum of the nominal metallic cross-sectional areas of all the wires in the strand and the circumscribed area of the strand.

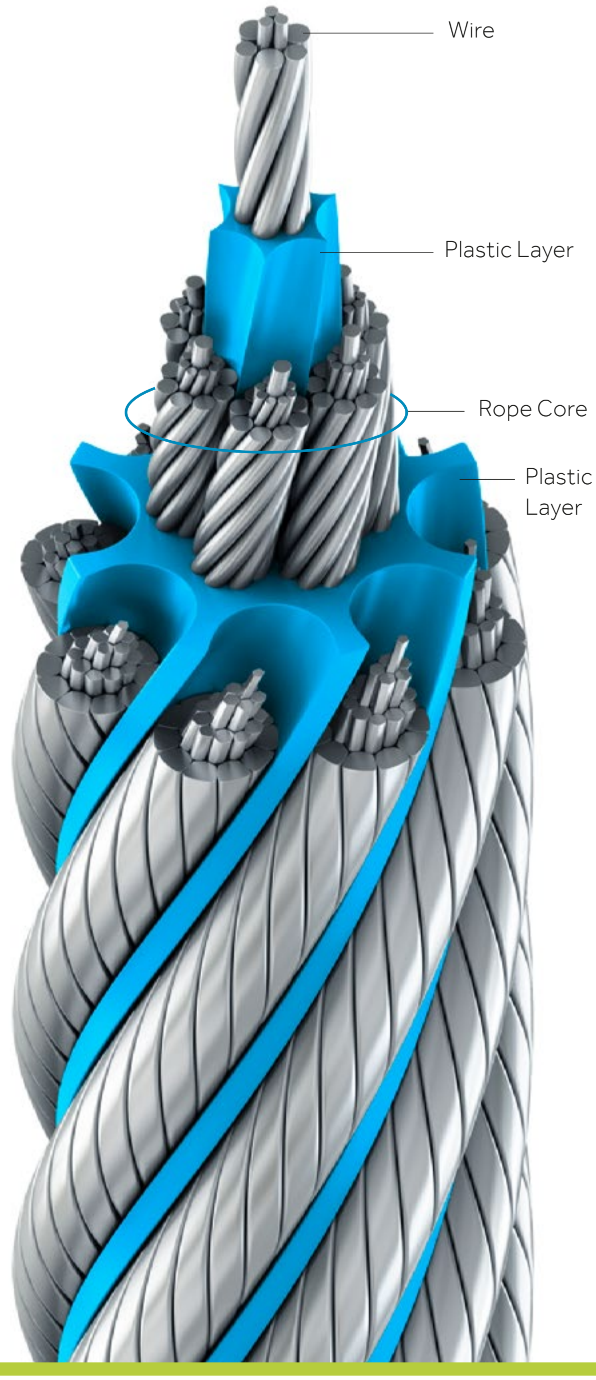


While conventional strands are designed with a fill factor up to 0.82 (or 82% amount of steel in the strand, depending on the strand design, e.g. Seale, Warrington Seale, etc.), the strand compaction can achieve fill factors of 0.90 and more.

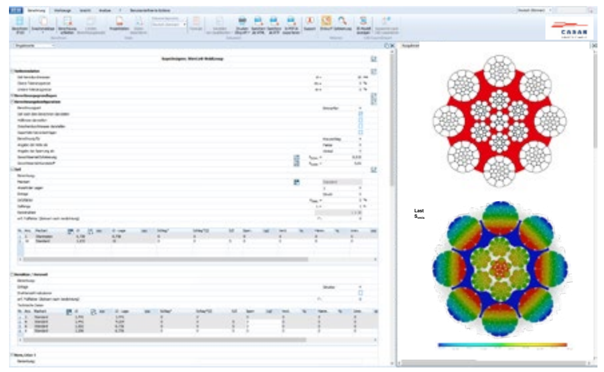


## The Wire Rope

A rope is an elongated, flexible, elastic element made of strands or wires laid up in a helix around a core for transferring tensile forces.

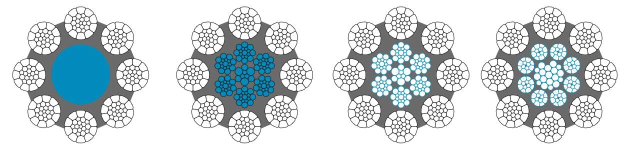



CASAR uses calculation programs and computer-aided tools such as CAD and FEM to design the strands and the rope. Properties such as the elongation behavior, torque or design parameters such as the lay length ratio are also validated by empirical tests in the laboratory and enable advanced dimensioning and optimization specific for the application.
As described, a wire rope consists of a large number of heli-



cally twisted wires or strands. Combined, the inner strands form the core or the heart of the rope. The outer strands usually give the entire rope its name and form the top layer. The outer strands of the CASAR special wire ropes are arranged helically around a core in accordance with strict geometrical laws. In turn, stranded wires, manufactured independently of – or in parallel with the outer strands are used as the core. The core is in most instances encased with a plastic layer. In addition, this plastic layer is heated during the final closing of the rope, to allow the outer strands to bed into the plastic layer. Thanks to the positive service life properties, the rope designs offer an extended range of applications (see also chapter "Plastic insert").
The structure of a rope is described by the number of its elements, e.g. for a rope with 8 outer strands of 26 wires each, the designation is "8 x 26".
Parallel stranding offers significant advantages over single-layer stranding due to the linear contact of the wires. The stress on the wire is reduced through the distribution of the internal pressures and significantly longer service lives are achieved.
The geometry of the strands is named after their inventor, Seale, Warrington and Filler, as well as the composite design, Warrington-Seale. In addition to the classic fiber cores and steel cores, fiber cores made of high-strength, high-

molecular, synthetic plastics are also used today, which, in contrast to the classic fiber core, are load-bearing (CASAR Turbolite M).



Core made out of synthetic fibers with plastic coating | independent wire rope core | independent wire rope core with plastic coating | parallel wire rope core with plastic coating

The different core types are defined e.g. in EN 12385. Core types are natural fiber core (NFC), synthetic fiber core (SFC) or a steel core (WC). Steel core designs are either a wire strand (WSC) or an individual wire rope (IWRC). A steel core, in which strands are parallel layed with the outer strands is specified with PWRC.

For steel wire ropes with a polymer covered core, for instance an independent wire rope core, the specification EPIWRC is used.

In the case of compacted core rope strands or compacted rope cores, there is a "K" added to the specification.

| Item or element | Symbol |
|---|---|
| **Single layer rope:** | |
| Fiber core | FC |
| Natural fiber core | NFC |
| Synthetic fiber core | SFC |
| Solid polymer core | SPC |
| Steel core | WC |
| Wire strand core | WSC |
| Independent wire rope core | IWRC |
| Independent wire rope core with compacted strands | IWRC(K) |
| Independent wire rope core covered with a polymer | EPIWRC |
| **Parallel-closed rope:** | |
| Parallel wire rope center | PWRC |
| Parallel wire rope center with compacted strands | PWRC(K) |
| **Rotation-resistant rope:** | |
| Central element | |
| fiber center | FC |
| Wire strand center | WSC |
| Compacted Wire strand center | KWSC |

## Rotation-Resistant and Non-Rotation-Resistant Ropes

A helically twisted wire rope tends to "untwist" to reduce its torque under load. The result is that every wire rope tends to rotate under load.

In a conventional or non-rotation resistant rope that consists of at least 2 strand layers that are twisted around the core in a helical form, the direction of lay of the outer strands matches that of the inner strands. All strands generate a torque under load that is directed in the same, i.e. opening, direction and the rope starts to twist or rotate.

A rotation-resistant rope has a steel core that functions as an independent rope and is closed in the opposite direction like the outer strands. Under load, the steel core tries to untwist in one direction while the outer strands try to untwist in the opposite direction. The rope is designed in a way so that the torques of the steel core and the outer strands compensate over a wide load range and thus almost no rotation occurs even at a great lifting height.

**Rotation-resistant**
The direction of lay of the outer strands is opposite to the direction of lay of the steel core.

**Non-rotation-resistant**
The direction of lay of the outer strands and steel core are identical.

The rotation resistance is mainly defined in two categories. As per ASTM A1023 the category 1 specifies rotation resistant rope types with in ISO 2166 defined rotation under load of less than or equal to 1 turn per length of 1000 times the rope nominal diameter (d) lifting a load equivalent to 20% of the rope minimum breaking force.

A category 2 rotation resistant rope, also referred to as semi rotation resistant, has a specified rotational property between 1 turn and 4 turns (per length of 1000d and a load of 20% MBF).

## Low-tension Wire Ropes / Preformed Ropes

Many non-rotation resistant ropes are preformed during manufacture. While the strands of rotation resistant ropes are forced to the helical form during manufacture and keep their inner forces, the preforming operation is forming the strand to the helical form before closing into the rope. Therefore, the preformed strands are closed to the rope almost without remaining tension.

## Locked Coil Ropes / Guide Ropes

Guide ropes and rubbing ropes for mining applications are usually locked coil rope types, mainly half-locked coil rope designs. This rope design is a spiral rope with a covering, outer layer of alternating shaped and round wires (half-lock). The shaped wires are called H-shaped wires. The advantage of this rope type is the big outer wire size, suitable for the guiding and rubbing usage.

## Flat Ropes / Balance Ropes

Today, flat rope types are used as balance (or tail) ropes for Koepe friction winder applications. The flat ropes are an assembly of individual ropes known as reddies, usually made out of four strands. The majority of flat rope are designed with 6.8 or 10 reddies in alternating left and right lay direction, which are either stitched together side by side by wires, strands or rivets.

## Wire Rope Diameter

When dimensioning new rope winders, the wire rope diameter is usually secondary to the required breaking force. On the other hand, in the case of an existing rope winder, the rope diameter is usually the first selection criterion. In both cases, however, it is important for the user to distinguish between the nominal diameter and the effective diameter and to understand the difference. The effective diameter results from the nominal diameter plus a certain design tolerance. CASAR special wire ropes are manufactured in a tolerance range between + 0% and + 5% (EN 12385). The rope diameters are usually at the upper tolerance limit, i.e. between + 2% and + 4%.

CASAR special wire ropes thus meet the requirements of all the renowned winder drum manufacturers and can be used on their products without reserve. However, limited tolerances and special tolerances can also be produced on request.

## Length of Rope

According to the EN 12385 standard, the actual delivered length of the unloaded rope must correspond to the nominal length, whereby the following tolerances apply:
For a length of up to 400m: 0% to + 5%
With a length between 400 and 1000m: 0m to + 20m
For a length over 1000m: 0% to + 2%
Different length tolerances can be produced on request.

## Direction of Lay

The wires in the strands and the strands of a rope always follow a winding direction or lay direction. This can be either left or right hand. When you look down a rope, strands of a right lay rope go away from you to the right. Left lay is the opposite. (It doesn't matter which direction you look.) The direction of lay is denoted by the letters Z for right-hand and S for left-hand.

## Type of Lay

Wires and strands can be laid in the same (Lang's lay) or opposite (Ordinary lay) directions, depending on the required rope properties. The distinction between the direction and type of lay between wire and strand is made using lowercase and uppercase letters.

**Ordinary Lay**

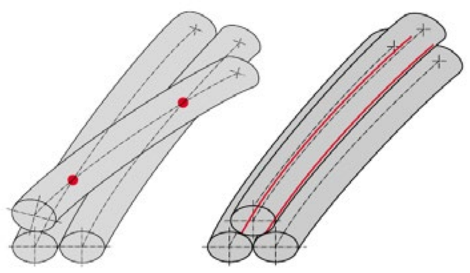
The wires in the outer strands are laid in the opposite direction to the outer strands in the rope. As a result, the wires are practically in one axis with the rope itself. The designation is sZ or zS, with the capital letter for the strand in the rope and the lower case letter for the wire in the strand. Ordinary lay is more resistant to kinking and untwisting, and less likely to fail as a result of crushing and distortion.

**Lang's Lay**

Both the wires in the strands and the strands themselves have the same lay direction. The wires are at a clear angle to the axis of the rope. The designation is zZ or sS.
Choosing the right lay direction is very important for the correct operation of a rope winding drum. Wrong lay direction can lead to a build-up of twist, spooling problems and structural changes within the wire rope. The advantage of using Lang's lay is that the rope offers a better wearing surface when in use, and therefore can be expected, in many cases to last longer. Lang's lay ropes produce higher torque values under working conditions.
Ordinary lay ropes offer a higher structural stability and can withstand higher radial forces. The allowed number of broken wires as per the rope discard criteria is higher and a broken wire is easier to identify, remove and is less likely to damage neighbouring wires.
Langs lay ropes offer a superior wear and abrasion resistance as well as a much better multi-layer spooling performance. Langs lay ropes have a better contact in the drum and sheave grooves and can achieve a longer service life.

## Lay Length

The lay length describes one revolution of a wire around the strand axis or one revolution of a strand around the rope axis. The lay length is thus comparable to the pitch of a spring. It is one of the decisive constructive parameters: long lay lengths result in a rather stiff rope, short lay lengths result in a very flexible rope. The correct lay length also has a major influence on rope elongation and rope service life. Changes in the lay length during operation of the rope can also indicate that the rope has neared the end of operational life.



*cross (non-parallel) lay stress concentration*   *parallel lay stress distribution*

## Parallel Lay

In a cross - (non-parallel) lay strand, all wires have different lay lengths and a cross - (non parallel) lay rope, all strands have different lay lengths. The high stress concentration at the crossover points leads to premature internal failure.
In a parallel lay strand, all wires have the same lay length, and in a parallel lay rope, all strands have the same lay length. The linear contact leads to an optimal stress distribution. The case of unequal lay strands of non-circular cross-section(s), increases the complexity of the analytical analysis significantly. Mckenzie (1989) noted that the complication in modeling mine winder steel wire rope strands arises from the non-uniform path of a wire around the strand axis. Conceptually, as a wire is followed, the radial distance between the wire and the strand axis changes from a maximum at the apices of the triangle, to a minimum along the flattened sides. Resultantly, varying contact surface areas, between individual mine winder rope elements, can be expected. However, in the instance of equal lay wires/strands, the associated degradation mechanisms are eliminated, as contact surfaces between the individual mine winder rope elements, are in parallel and react uniformly with changes in the lay length of the mine winder rope.

## Lubrication

It is a misconception that, galvanized mine winder ropes do not have to be lubricated. The zinc coating only fulfils one of the two tasks that a lubricant performs, i.e. protection against corrosion. A lubricant is also required to reduce the friction between the large number of the mine winder rope's elements in contact with each other within the rope, and on the outside whilst running over sheaves and wound onto the winder drum. This requirement can only be achieved by the zinc coating in a very insubstantial way. Although static galvanized mine winder rope(s) can be applied without lubricant, a running mine winder rope will have a reduced useful service life, unless lubricated on a regular basis. If required, mine winder ropes can be galvanized (Category 2). To provide the additional required protection against corrosive elements, and act as a lubricant to minimise abrasive wear, mine winder ropes are lubricated during manufacture, with Elaskon SK-39/07oL. It is recommended that the mine applies Casar recommended lubricants for in-service lubrication, i.e. Elaskon SK-39/07oL.
These lubricants are specially formulated adhesive lubricants for the maintenance of mine winder ropes. The lubricant contains anti-wear, anti-rust, mild extreme pressure additives and deep penetrating wet ability agents. The additive treatment in these oils, protects the mine winder rope against water wash off and penetrates into the mine winder rope strands, guarding against corrosion.

## Corrosion Protection

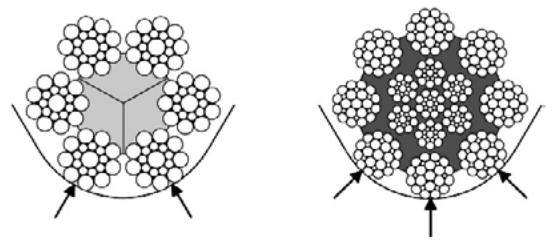
If required, ropes can be hot-dip galvanised or electro-plated to provide additional protection against corrosion. To provide the additional required protection against corrosive elements, and act as a lubricant to minimise abrasive wear, ropes will be lubricated during manufacture, with Elaskon II Star. It is recommended that the mine use CASAR approved lubricants for in-service lubrication. These lubricants are specially formulated adhesive lubricants for the maintenance of wire ropes. They contain anti-wear, anti-rust, mild extreme pressure additives, and deep penetrating wet ability agents. The additive treatment protects the rope against water wash off and penetrates deep into the rope strands, guarding against corrosion. These oils can contain a solvent and can be applied by spray, leaving behind a durable film of corrosion protection once most of the solvent has evaporated. It is applied at ambient temperature.
In addition, ropes are typically covered with Lamiflex on the drum reels, to provide for additional protection against harmful elements and corrosion, whilst in storage.

## Size of Outer Wires

It is a known fact that, mine winder ropes with larger, more robust outer/crown wires, perform better in multi-layer spooling. The diameter of the outer/crown wires of a Seale 19 strand, is 42 % greater than those of a Warrington-Seale 36 strand. Their metallic cross-section is 100% greater and therefore, more robust and abrasion resistant. A significant degree of plastic deformation of the outer/crown wires is anticipated in this instance, specifically at the layer cross overs. Experience on mine winders with similar tread pressure(s), has shown that, should the plastic deformed section of the adjacent wires overlap each other, delamination of the outer surface of the wires can be expected. Larger outer/crown wires will allow for an additional amount of plastic deformation, before the outer/crown steel surfaces of the outer/crown adjacent wires, come into contact with each other. However, fatigue performance is sacrificed and therefore, careful consideration has been applied in the selection of the optimum mine winder rope design.

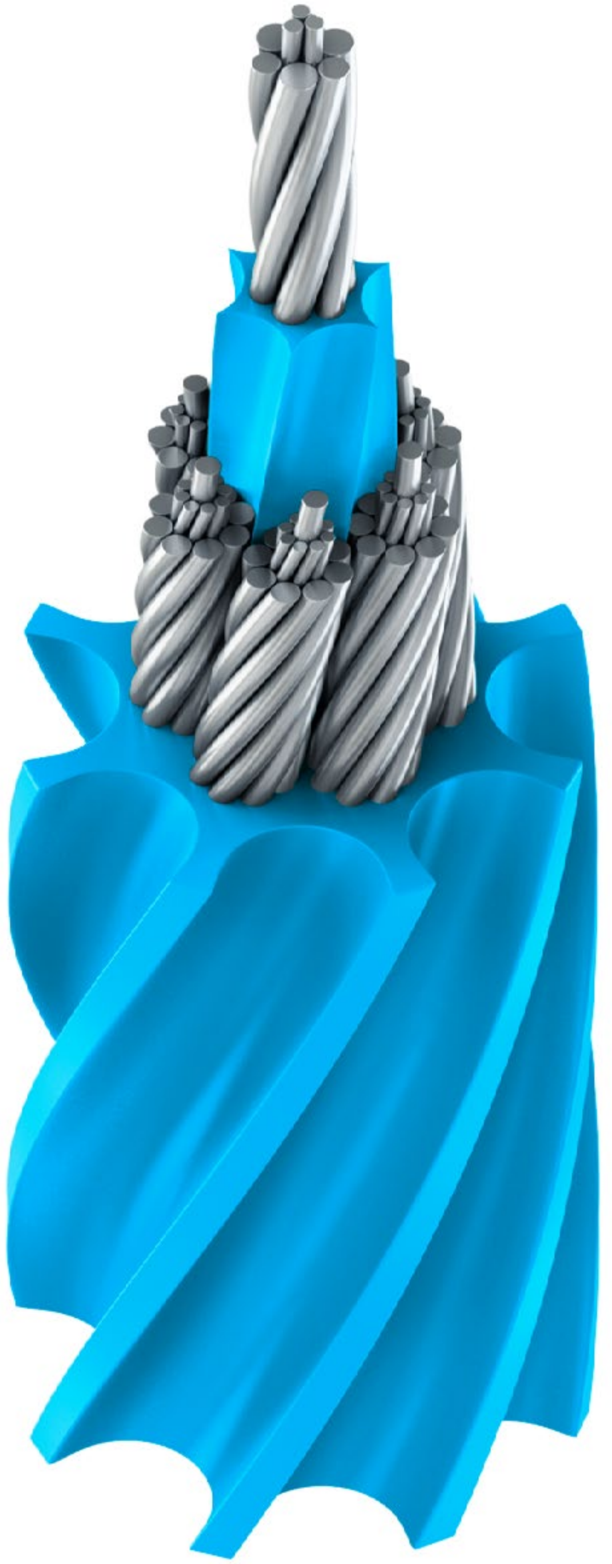
## Increased Number of Outer Strands

Increasing the number of outer strands results in a more flexible rope, another significant contributing factor towards resisting fatigue failures. Contact stresses between the outer strands and drum sleeves/sheaves as well as between the inner strand elements are also reduced by compaction of the strands. Internal protection against abrasion and harmful elements are provided by the plastic layer, and high contact stresses within individual strands (wires) and between the strands, is significantly reduced, by manufacturing all the strands and wires within the rope with an equal lay-length. The result is that all elements within the rope, work in unison to ensure no excessive contact stresses are generated in some of the strands or wires



The outer lay for the Turboplast MF is made up of eight (8) compacted outer strands. These eight strands are closed over an Independent Wire Rope Core (IWRC), with a protective plastic layer between the IWRC and outer strands and also protruding between the outer strands. All strands are compacted to allow for the maximum cross-section of steel for a given rope diameter. As a result, the increased cross-section of steel allows a similar reduction in stresses within the individual rope components and thus a significant increase in resistance to fatigue.

## The Plastic Layer ...



**... greatly lowers, or even removes, the incidence of birdcaging**

**... lowers the noise level whilst the rope is working**

**... prevents internal wire breaks**

**... prevents metal-to-metal contact**

**... absorbs dynamic energy**

**... stabilizes the rope structure**

**... prevents interstrand nicking**

**... seals in lubricant**

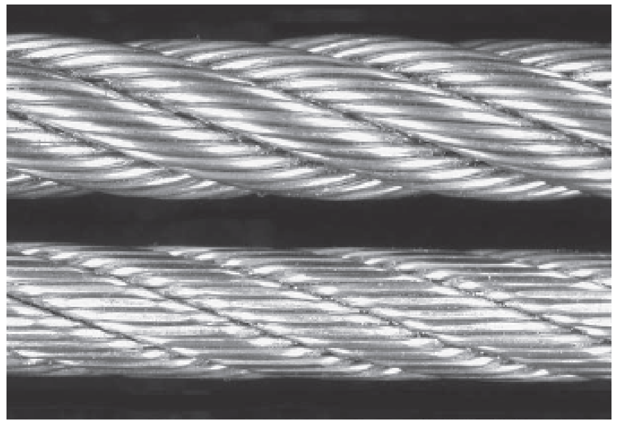
**... stabilizes the rope during the installation**

**... acts as a cushion between the layers**

**... keeps out water and abrasive elements**

## Swaged Ropes

Most of the damage a wire rope will be subjected to during multi-layer spooling is caused by the rough outer surface of the rope itself. So it would only seem logical to smoothen the rope surface to reduce the damage.
Steel wire ropes cross-sections are often referred to as being "round". But they are not round at all! Depending on the number of outer strands of the rope, the cross-sections resemble a hexagon or an octagon much more than a circle! The sequence of crowns and valleys along the circumference is the main cause for all the problems experienced by a muti-layered spooling winder rope. To improve the rope performance, we must attempt to make the rope cross-section round!
Casar has achieved tremendous round cross-sections and extremely smooth wire rope surfaces by hammering different types of steel wire ropes using a rotary swaging machine. Great care has been taken to avoid internal wire rope damage caused by the swaging process itself. The swaged ropes have been tested on normal bending fatigue machines and the Casar multi-layer test stand. The results have been very encouraging: On the multi-layer test stand, on average the swaged ropes achieved about 3 times the life of the comparable unswaged designs.



The same rope before swaging (top) and after swaging.
Hammered ropes have much greater contact areas with the grooves of sheaves and drums than conventional steel wire ropes with a "rough" surface. This leads to much lower contact pressures and as a consequence to much lower sheave, drum and rope wear.
Casar offers a variety of hammered steel wire ropes. They can be identified in the Casar rope catalogues by the name ending "fit". Compared with conventional steel wire ropes, these rope designs offer an increased breaking strength and excellent rope life on multi-layer drums.

## Overstressed Components

Any mine winder rope elements not reacting uniformly during loading results in such elements becoming overstressed. As an example, the use of a wire main core (WMC) or "King Wire" within the Independent Wire Rope Core (IWRC), can cause such a wire to become overstressed, in contrast to the rest of the mine winder rope. The reason is that all elements are laid up in a helical shape, whereas the WMC is a single wire, positioned in a straight plane in the core of the rope. As the rope elongates during normal cyclic service, this single wire will elongate significantly more than other elements laid up helically and could fail prematurely. An increase in mine winder rope steel area, with a constant payload, reduces stresses within individual elements and as a result, significantly prolongs the useful service life of such a mine winder rope. Stress concentrations within the outer/crown wires, due to plastic deformation, resulting in the premature fatigue failure of such a wire, is less of a factor, when the stress in such a wire is decreased, due to an increase in mine winder rope steel area.

## 2. TECHNOLOGICAL ADVANCE OF CASAR HIGH PERFORMANCE MINING ROPES

**Following rope property definitions as per EN12385 can be found in our documentation:**

- The rope grade (Rr) is defined as a level of requirement of breaking force which is designated by a number (e.g. 1770, 1960).
  NOTE: It does not imply that the actual tensile strength grades of the wires in the rope are necessarily of this grade.
- Nominal metallic cross-sectional area (A) - the product of the nominal metallic cross-sectional area factor (C) and the square of the nominal rope diameter
- The fill factor (f) is the ratio between the sum of the nominal metallic cross-sectional areas of all the wires in the rope (A) and the circumscribed area (Au) of the rope based on its nominal diameter (d)
- The spinning loss factor (k) is the specified minimum aggregate breaking force (Fe.min) and the specified minimum breaking force (Fmin) of the rope, as determined from the ropemaker's design.
- Minimum breaking force (Fmin) – specified value in kN, below which the measured breaking force (Fm) is not allowed to fall in a prescribed breaking force test.
- Measured breaking force (Fm) – breaking force obtained using a prescribed method
- Minimum aggregate breaking force (Fe.min) – specified value, in kN, below which the measured aggregate breaking force is not allowed to fall in a prescribed test and normally obtained by calculation from the product of the square of the rope diameter (d), the metallic crosssectional area factor (C) and the rope grade (Rr).
- Measured aggregate breaking force (Fe.m) – the sum of the measured breaking forces of all the individual wires taken from the rope
- Nominal rope length mass (M) – that value derived from the product of the length mass factor and the square of the nominal diameter.
- Measured rope length mass (Mm) – the mass of 1 m of rope as determined by weighing

## Tolerances

CASAR Mining ropes are subject to tolerances outlined in EN12385.

## Rope Breaking Force

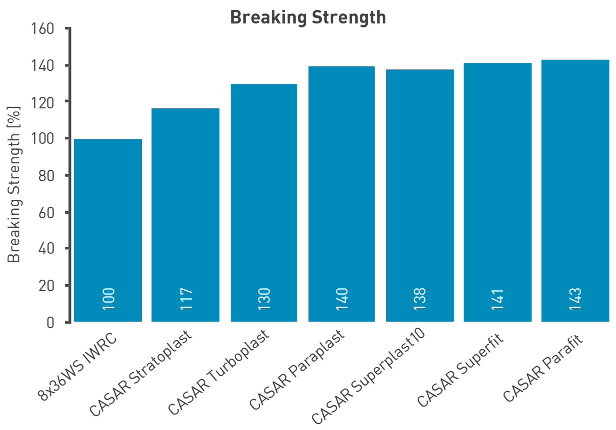
Conventional steel wire rope constructions can meet a requirement for higher breaking loads only by increasing the tensile strength of the individual wires.
Casar Special Wire Ropes are already designed for the highest breaking loads by a combination of various technologies:

- A large number of strands increases the metallic area of the rope.
- Parallel lay leads to a more compact rope construction.
- A plastic layer reduces internal stresses.
- Compacting of the strands increases the fill factor of the rope elements.
- The tensile strength of the wires is chosen according to the requirements.

The high breaking loads of Casar Special Wire Ropes offer the user the following advantages:

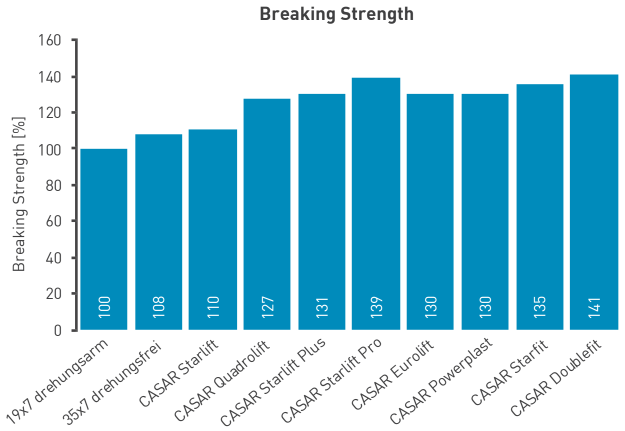
- Design advantages by reducing the sheave and drum diameters and the size of motor and gearbox.
- Longer service life due to lower specific stress on the rope.
- Increased safety.

**Comparison of Non-Rotation Resistant Ropes**






**Comparison of Rotation Resistant Ropes**



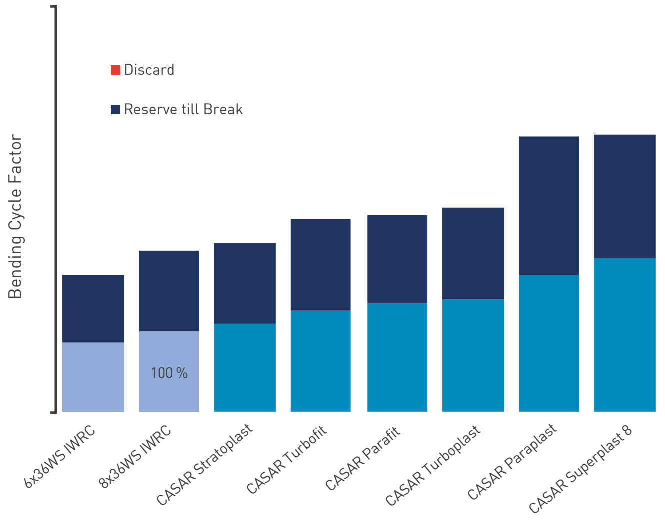

The breaking forces and the fill factors of the CASAR special wire ropes are significantly higher than the breaking forces of the standard designs (DIN EN 12385-4).
The fill factor indicates the ratio between the metallic area of the perimeter of the rope and the actual area from the sum of the individual wires. A high fill factor usually leads to a higher breaking strength, but also increases the weight per meter. Especially the hammered FIT ropes stand out particularly.
Also with the rotation resistant ropes, the advantages of the highly specialized design and manufacturing knowledge are clear. The breaking forces actually achieved in the test are on average approx. 10% above the minimum breaking forces. This safety has proven to be economically advantageous for the user, since no unnecessarily high reserves are left unused in the design of the rope drive.
The bundling of wires into a strand and the strands into a rope is necessary in order to allow the necessary bending flexibility for the overrun of sheaves. The price paid for flexibility, however, is a loss in breaking strength versus a bundle of parallel wires. This loss caused by the helix shape is referred to as stranding loss. CASAR special wire ropes show extremely low stranding losses compared to the standard ropes.

## Rope Fatigue

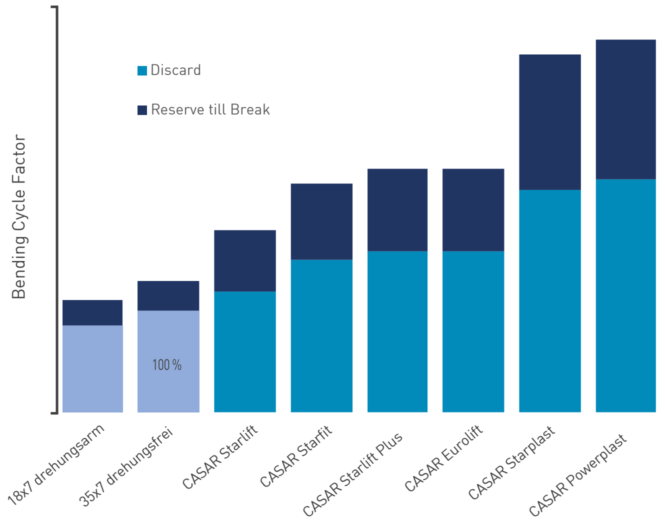
In addition to the breaking force, the service life of the rope is one of the main characteristics of CASAR special wire ropes.
Compared to the standard, they are characterized by a significantly longer durability or rope service life as well as a high level of remaining safety before a strand or rope break occurs. The high number of bending cycles remaining after the discard status has been reached enables a timely rope change.
CASAR has a test lab with more than 10 testing machines, including 2 permanent bending machines. Above all, the principle of multiple bending per movement cycle has proven itself: While with classic continuous bending machines there is usually only one bending cycle per machine cycle, 5 sheaves are rolled over on the testing machine, i.e. 10 bending cycles.


Following diagrams show the service life values determined in the laboratory on a permanent bending machine with the same relative loads and with the same diameter ratio (D / d = 20) for the non-rotation resistant CASAR ropes as well as the rotation resistant CASAR ropes.

**Endurable Bending Cycles (non-rotation-resistant)**




**Endurable Bending Cycles (non-rotation-resistant)**




## Rope Rotation Behavior

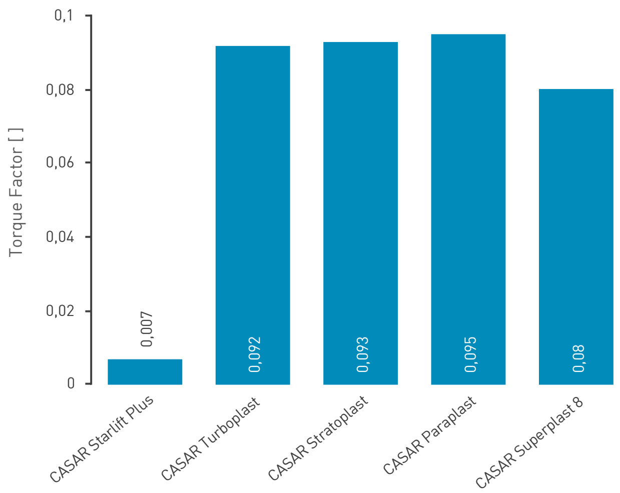
Conventional wire ropes try to untwist under load. Stability can often only be achieved by overloading the core of the ropes. Rotation-resistant Casar Special Wire Ropes are stabilized against rotation by various technologies.

- A wire rope core, closed in the opposite direction of the outer strands, creates a stabilizing moment.
- A compacted core increases the rotational stability.
- A favourable ratio of the metallic areas leads to stability without overloading the core.

The high rotational stability of Casar Special Wire Ropes offers the user the following advantages:

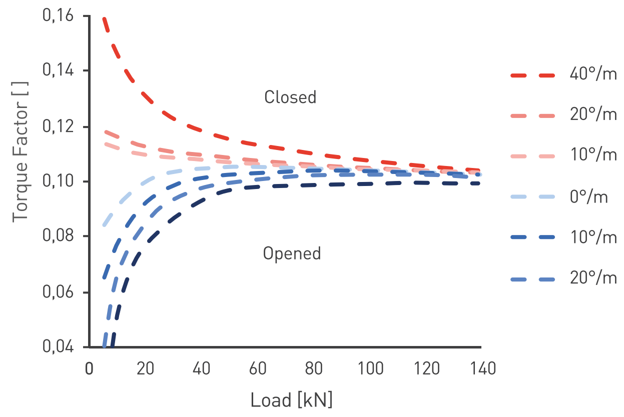
- No block rotation even with great lifting heights.
- Long service life because of an untwisted rope structure.
- Great safety in mining operations.

**Torque Factors of Different CASAR Special Steel Wire Ropes**



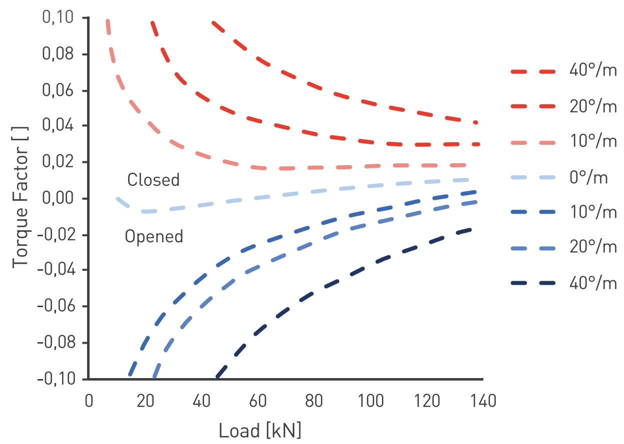

Rotation resistant ropes have a small torque factor, but build up a very high torque resistance when twisted violently. Non-rotation resistant ropes such as the Stratoplast naturally tend to untwist, but are more robust against violent twisting, for example due to larger deflection angles.

**Torque factor of a non-rotation resistant rope as a function of the load for different angles of violent twisting (Casar Stratoplast d19 / 180):**



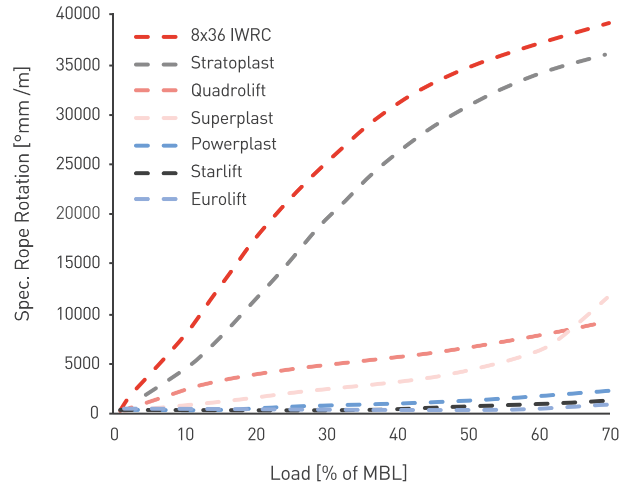

The torque factor is only marginally influenced by the twist. In contrast to this, the torque factor of a rotation resistant rope is significantly influenced by an external twist.

**Torque factor of a rotation resistant rope as a function of the load for different angles of forced twisting (Casar Starlift d19 / 180).**




Conversely, a measurable twist for each reference length can again be determined earlier in the case of non-rotation resistant ropes.

**Specific rope twist (twist x rope diameter / rope length) depending on the load.**

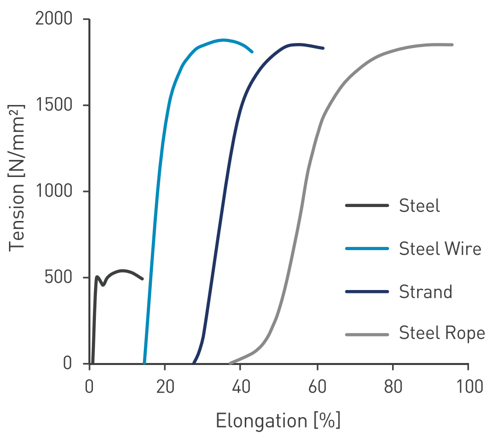



Rotation resistant ropes only show measurable twisting significantly above the loads that occur in use.

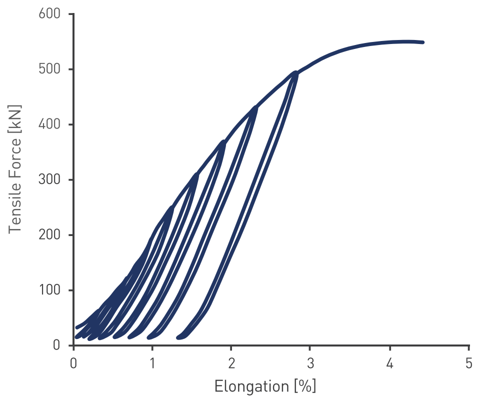
## Rope Elasticity and Elongation

The wire rope manufacturing is stranding and closing the rope wires to the rope design. With the first loading of a new rope, all rope wires experience their first load and move very slightly in order to find their optimum places. This bedding in of the assembled wires results in an elastic and a remaining change in the rope diameter as well as the rope length. There is a certain reduction in rope diameter and with it a lengthening of the rope. With repeating the loading and unloading of the new rope as well as experiencing the first bending, the rope is lengthening until the bedding in is completed. This initial, remaining extension of any new rope is not accurately possible to be calculated and can amount up to 5%, which particularly depends on the rope construction and load. This is accompanied by a more or less distinctive reduction in diameter, depending on the rope's design.

**Comparison of the stress-strain curves of steel, steel wire, stranded wire and steel wire rope.**



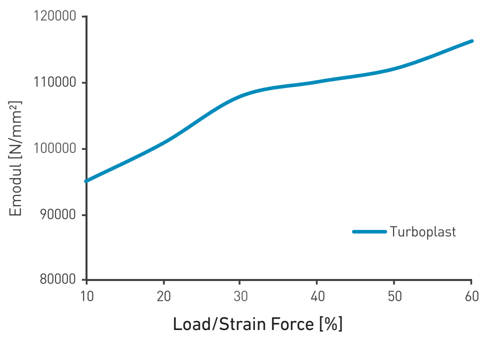

The actual elastic expansion is reversible and proportional to the load. A rope with a high E-modulus tends to be stiff, whereas a rope with a low E-modulus tends to have a high energy absorption capacity and is correspondingly less sensitive to shock loads.



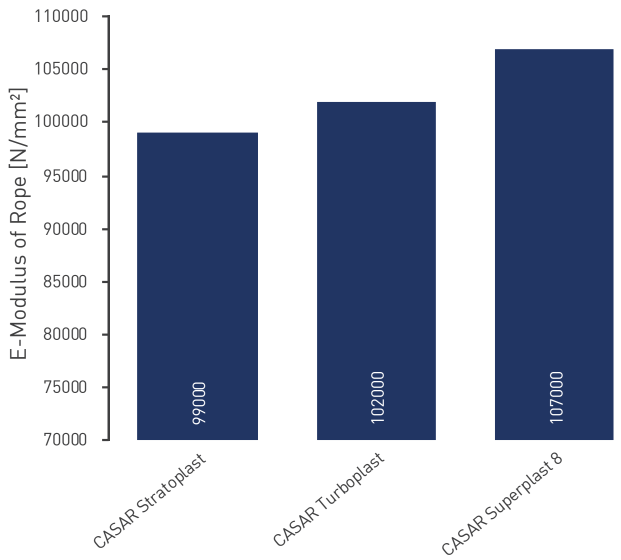

**Load/Strain diagram for a wire rope**

The following diagram shows the E-modulus for various CASAR ropes as the average value from the load between 10% to 60% of the MBL. In addition, the E-modulus was averaged over a diameter range from 16mm to 50mm.

**Load/Strain diagram for a wire rope**

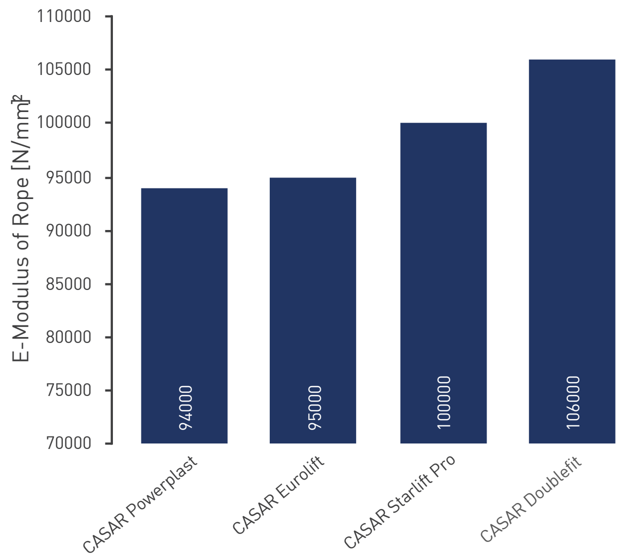



**Rope E-modulus of non-rotation resistant CASAR Special Wire Ropes**




The values for the E-modulus of the ropes are about half as high as the value of steel. The values given in the diagram are average values from a large number of tests with different diameters.

**Rope – elastic modulus of rotation resistant CASAR Special Wire Ropes**




The realistic figures are depending on many influences, most important the type of rope and rope design, the range of loads as well as the number and frequency of loading cycles of operation.

Conventional steel wire ropes often have insufficient modulus of elasticity and permanent elongations that are to high.

Casar Special Wire Ropes are optimized with regard to their stress strain properties by various features:

- The full steel construction provides a high modulus of elasticity.
- The compact rope structure guarantees minimal permanent elongations in the working range.
- The homogeneous load distribution on all rope elements creates high elongations at break.
- The plastic layer absorbs dynamic energy.

The balanced stress-strain properties of Casar Special Wire Ropes offer the user the following advantages:

- High rigidity of suspended structures.
- Less retentioning for suspended structures and positioning machines.
- High safety against dynamic failure.

Another important remark, with reference to rope elasticity, is that it does not possess a Young's Modulus of Elasticity. While a theoretical estimation of the elastic extension can be calculated (refer to below), a more accurate result is determined by a practical modulus of elasticity test measurement on an actual sample of a rope. This modulus of elasticity measurement is a usual part of our high performance mining rope quality assurance and is included in the sales order quality documentation.

**Elastic Extension (mm)** $= \frac{F * l}{E * A}$

with:
F = load (kg) l = rope length (mm)
E = modulus of elasticity (kg/mm²)
A = circular area related to the rope nominal diameter (mm²)

Prior to comparing suitable mine winder rope designs, in relation to duty cycle calculations and mine winder rope useful service life prediction results, specific rope design attributes have been selected, in accordance with the key rope attributes identified, for this specific installation. To achieve the optimum mine winder rope useful service life, the main requirements identified during rope selection are summarised as follows;

## A High Performance Multi-Stranded Rope

The simplest mine winder wire ropes are manufactured by closing steel strands around a central fiber core. In a new mine winder rope, the fiber core acts as an elastic bed for the outer strands and as a reservoir for the rope's lubricant. When subjected to high dynamic loads, the fiber core is compressed and the mine winder rope is lengthened, thereby reducing high peak loading. With increased useful service life, these advantages rapidly turn into disadvantages. The lubricant is squeezed from the fiber and replaced by water from the atmosphere. The mine winder rope's basic geometry is also altered, as the stability of the fiber core reduces over time. The fiber core reduces in diameter, leading to strand-to-strand contact and to early mine winder rope deterioration. Under high radial forces, the geometry of mine winder ropes, with a fiber core(s), is not sufficiently stable.

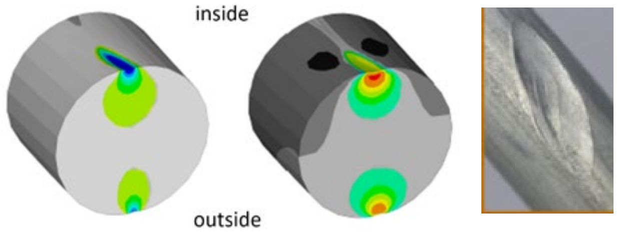
Multi layered full steel mine winder ropes have enhanced advantages. However, full steel mine winder wire ropes, with independent wire rope cores, are exposed to a number of contact pressure points between certain mine winder rope elements. Contact points, where strands of the core come in contact with the outer strands, cause internal damage. Double parallel mine winder ropes are specifically designed, where the inner and outer strands lie parallel to one another. This avoids the extreme crossover contact points found in conventional full steel mine winder ropes, which lead to premature failure. Due to the unique construction of Casar's multi-stranded mine winder ropes, denser compositions than conventional types achieve higher breaking loads.

As an example, WireCo's CASAR StarPlast VM is rotation resistant, essential for increased depth of wind Koepe Winder applications. The StarPlast was designed for increased depth of wind applications; a proven design, with a proven record. CASAR Starplast VM Rotation-resistant rope will find equilibrium, by shortening and lengthening of opposing layers (high torque resistance, limited negative rotation). However, stresses in opposing layers are near equal, as the product of the cross-section of steel and radii, is equal. High stresses between opposing layers are eliminated, as a negative torque factor will decrease pressure between the opposing layers at a position where normally the opposite can be expected! Furthermore, due to a protective plastic coating between these layers and the opposing layers reacting uniformly, rotation and subsequent slackening or over-tightening of strands, in the opposing layers, are reduced to a minimum

The increased number of outer strands of the rope results in a rope that, is more flexible, resistant to fatigue, and less prone to damage caused by external contact stresses. The rope's ability to withstand abrasive wear is also significantly improved as a result. Increasing the number of the outer strands results in a higher number of contact points and a subsequent reduction of contact stresses at every contact point. Although the size of the outer strands and as a result, also the outer wire diameter, is reduced, the effective contact area of the outer wires is increased, through compaction and thus more resistant against abrasion and corrosion.

The high contact stresses within individual strands (wires) and between the strands in the IWRC are significantly reduced, by manufacturing all the strands and wires within the strands with an equal lay-length. The result is that all elements within the core of the rope, work in unison, to ensure no excessive stresses are generated in some of the strands or, wires.

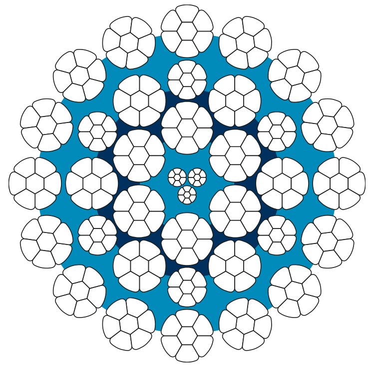
By design, the contact stresses between the opposing directions of lay, are limited to a single plane, between the outer strands and IWRC. The stresses between these elements are eliminated by a plastic inlay, which prevents the respective strands from making contact and also significantly improving the rope's ability to withstand shock loads. The integrity of construction is also maintained during installation, by the plastic layer




Lubrication is applied to the IWRC core during manufacture and is sealed in by the plastic layer for the lifetime of the rope. The plastic layer also ensures that contaminants are prevented from entering the rope core.

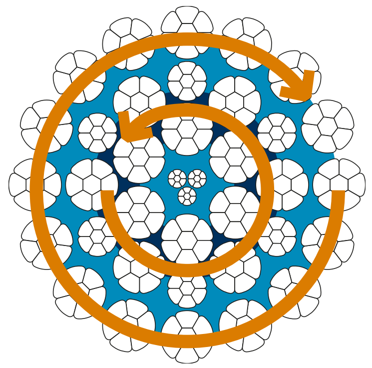
With the ever-increasing demand to mine at greater depths of wind, extensive research and development was undertaken to afford WireCo the ability to provide the end-user with a product that, can meet these demands, cost-effectively. The result was the design and development of StarPlast VMF, a significantly improved version of the StarPlast VM (already an unmatched and leading rope design at the time). Significant changes to the design include; replacement of the wire main core (WMC) by helically formed strands and coating of these formed strands with a plastic layer. The rope, therefore, is manufactured with two layers of plastic. This ensures all elements in the rope react in the same manner under load, and no single element is subjected to premature failure.





Starplast VM

Both the mass per meter and tensile breaking force are comparable with the StarPlast VM but, the design has significantly improved performance characteristics, for deeper lengths of wind and ensured that also the center core was stabilised effectively to match the fatigue performance of the outer strands



Starplast VM

The opposing directions of lay are made up of typically sixteen outer strands generating a moment in one direction, which is balanced by a total of nineteen strands creating the counteracting torque or moment. During the manufacture of the IWRC, a large number of strands are densely packed by parallel closing. The result is that the metallic cross-section of the IWRC is now considerably greater than that of the outer strands.

Equal stresses between the outer strands and the IWRC core is achieved by this design and process. The disadvantage of the IWRC strands having shorter lever arms, is compensated for by a greater metallic area in each strand and consequently by having greater force components. The greater number of the strands in the IWRC, accounts for the rest. This design makes it possible to compensate the moments of the IWRC and the outer strands, for an extensive load spectrum. The high metallic area of the IWRC is made possible firstly, by compaction of the individual strands but also, by further compaction of the complete IWRC, after closing. This is a patented manufacturing process, registered by WireCo (US Patent No. 4454708).

As the torque and stresses are near equal, the residual moments are near equal, resulting in a torque factor, near-zero (rotation resistant). As a result, the typical torque related problems encountered in a Koepe winder head rope, are eliminated.

CASAR's StarPlast VMF combines both of the essential criteria; rotation and fatigue resistance but, also the magnitude in stresses present in the opposing lays of stranding is kept near equal, resulting in a very stable rope under all winding conditions, and no over-stressed elements in any of the opposing layers. The combined effect resulting in improved service life.

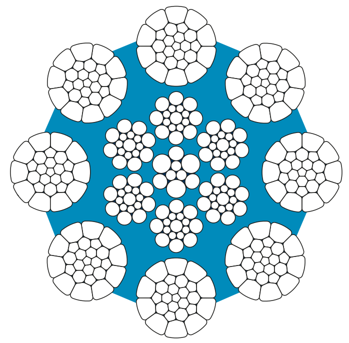
Where existing winding parameters or certain requirements are in place as to make the preferred rope designs not feasible, these requirements can be discussed with CASAR's engineering team, to allow for CASAR to quote for the optimum and most cost-effective solution.

## WireCo CASAR-Multi-Stranded Ropes

The WireCo Casar speciality hoisting ropes deliver precisely engineered and custom designed solutions for each application.

Proprietary designs deliver record setting service life.

Lower torque designs and innovative wire arrangements require less maintenance and resist drum crushing, lowering cost of ownership and improving mine profitability.



Turboplast MD

Decades of global mining experience and on-site engineering support help enhance safety and further improve rope performance.

The following are key attributes of WireCo Multi-Stranded Ropes.

- Parallel lay ropes, where all wires and strands have the same lay length. The linear contact leads to an optimal stress distribution. Furthermore, the compacted parallel design leads to a higher fill factor and breaking strength.
- Plastic covered steel core, where the proportion of plastic to the steel components is thoroughly harmonized in order to fulfill the aspired rope geometry. A plastic coating with a constant thickness and quality is extruded around the steel core. A thermal after treatment just before the closing of the rope ensures that the outer strands are embedded in the plastic jacket, thus forming plastic edges, which separate the outer strands. This aids to prevent internal wire breaks, prevent metal to metal contact, stabilizes the rope structure during installation and operation, seals in the lubricant, keeps out water and abrasive elements, absorbs dynamic energy and offers resistance to many chemical substances.
- Compacted strands have a higher breaking load, a greater flexibility and better rope-to-rope contact conditions than comparable ropes made of conventional round strands. Because of the thicker outer wires and the smaller exposed area they are more resistant to abrasion and corrosion. The formation of negative impressions on drum grooves and sheaves, is significantly reduced and the rope life on multiple layer drums is optimized.
- Lubrication is applied during the manufacturing process. This ensures the rope is provided with ample protection against corrosion and it is meant to reduce the friction between the elements, which make up the ropes as well as the friction between rope and sheaves or drums.
- Production tolerances are kept to within a range of +0% to +4%. However, special tolerances or limited tolerance ranges can also be covered.
- Ropes provided are of good quality and free from any visible defect and of adequate strength. All ropes are tensile tested to destruction at Casar's manufacturing facilities for which a certificate of conformance is issued.
- All WireCo manufacturing facilities are accredited in terms of ISO 9001: "Quality Systems—Model for Quality Assurance".
- Ropes are Magnetically Tested post production process, in order to confirm production consistency.

## 3. THE MOST COMMON CAUSES OF ROPE FAILURE – DRUM WINDERS

Casar mine winder ropes reduce winding rope ownership costs by offering ropes capable of operating for a significantly increased number of cycles when compared to traditional rope designs commonly available in the open market. In addition, Casar mine winder ropes are capable of increasing payload for the same diameter rope, through increased lifting efficiency and compacted strand designs. Casar's mine winder ropes are typically costlier than standard mining ropes. The main reason for the increased cost is the significant difference in quality and design of the rope construction (including galvanising, compacted strands, and a plastic layer between the steel core and the outer strands). However, it must be noted that the prediction of the service life of a mine winder rope can never be determined accurately. All mine winder ropes have a finite useful service life and to ensure safe operation, mine winder ropes must be inspected and examined at regular intervals so that, the mine winder ropes are replaced well before failure. In present times, shaft engineers, need a rough estimation of the useful service life of mine winder ropes to compare value and to ensure ropes supplied, are fit for purpose. The mine winder rope(s) proposed by Casar for a given installation, are selected based upon the rope specifications as listed in the information provided by the end-user, following the necessary duty and rope life prediction calculations. The topic of drum winder rope deterioration has been well documented in the past, including key effects such as tension, bending and torsion fatigue, as well as wear



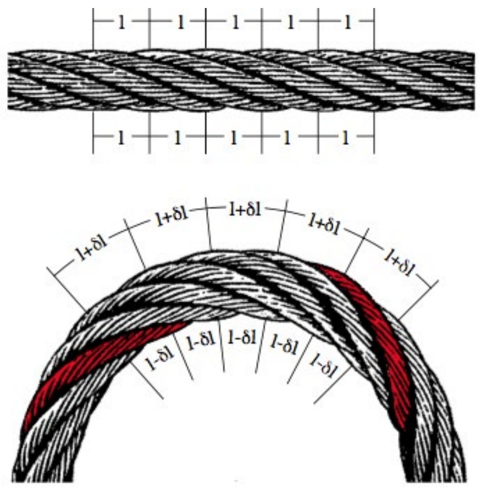
and plastic deformation associated with radial pressure and back-slip of the mine winder rope on the drum, due to changes in skip loading during the winding cycle. Numerous reports and articles have also been published, focusing on deterioration mechanisms of drum winder ropes discussing the effect of drum and head sheave sizes, number of rope layers, and the maximum dynamic rope load range on triangular stranded rope deterioration.

### Key Influencing Factors

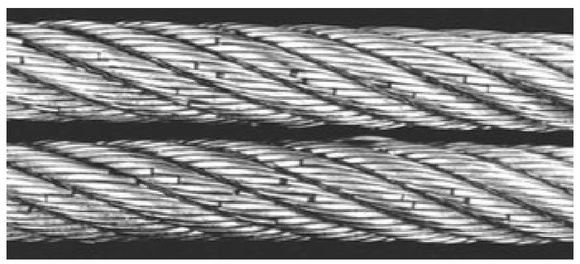
To better understand the reasons for the premature failure of mine winder ropes, especially at depth, the key influencing factors introduced into such a rope(s), requires analysis. Furthermore, the capability of the different mine winder rope construction(s), to withstand these factors and how their inherent deficiencies can be addressed, need to be considered. Findings of research done by Rebel and Vereet resulted in a method, whereby a number of influencing factors can be taken into account, to determine the expected rope deterioration rate. It must be noted that the primary degradation mechanism of mine winder ropes operating on parallel grooved multi-layer mine hoisting drums, is generally external wear and plastic deformation, at the half turn and layer cross-overs, towards the drum end of the ropes. In the paper presented by Rebel and Vereet, the influence that, (i) nominal radial crushing pressure on the drum, (ii) cyclic changes in rope load and (iii) sheave and winder acceleration issues, have on the rate of rope deterioration, need to be discussed as the same is considered in Wireco/Casar's rope selection. Further factors such as actual rope contact areas and geometry are considered in the analysis and recommendation(s) are made aligned to the optimum rope design and maintenance regime(s) for a given application. The main factors considered, resulting in the deterioration of deep level, non-rotation resistant, mine winder ropes, can be summarised as follows;

**Fatigue**

Wire rope bending fatigue is caused by running over sheaves or, on and off single layer drums. When a wire rope is bent around a sheave, each strand along its length comes to lie alternately on the outside of the bend, where it is lengthened, and on the inside, where it is shortened. Within a given strand, bending therefore causes lengthening (and tensile forces) in one place and – a few millimeters further on – shortening (and compression forces) in another. When bent around the same sheave, a rope with a helical arrangement of strands will therefore be subjected to much lower bending stress than a rope with a parallel, bundle-like arrangement of strands. This fundamental is why a closed wire rope, running over sheaves, will have a considerably improved useful service life, than a simple bundle of strands. When lifting a load, a radial force is generated in each strand, caused by the angle of lay against the rope axis.




Lengthening/shortening of individual strands



Fatigue cracks in a steel wire rope

A fatigue crack generally starts at the point of contact between the outer wires and the sheave or drum surface or at cross-over points, between individual rope wires. The fatigue crack then propagates, with the increasing number of cycles. With the increasing number of bending cycles, the fatigue crack will grow, reducing the load-bearing wire cross-section. Once the remaining wire cross-section is no longer able to carry its share of the load, the wire will fail, creating a fracture, which is perpendicular to the wire axis. Fatigue breaks occur more often on the inside of the bend (at the point of contact with the sheave) than on the outside of the bend (at the points of highest bending stresses). Wear or corrosion may contribute to the increased rate of fatigue crack formation and propagation. Good wire rope lubrication and re-lubrication during service will reduce the friction between the rope elements and therefore, improve steel wire rope fatigue resistance.

**Bending Cycles over Sheaves**

One bending cycle, for a given mine winder rope section, is defined as a change from a straight to a bent and back to a straight condition or, vice versa. Each time the mine winder rope section travels over a sheave, it is subjected to one bending cycle. During a typical lift, not every mine winder rope section will travel over the same number of sheaves and onto the drum. Therefore, along the mine winder rope length, rope fatigue is pronounced at those sections, which travel over the greatest number of sheaves, i.e. where it is subjected to the greatest number of bending cycles.
Where a mine winder rope section travels on and off a grooved single layer drum, the mine winder rope will undergo a change from a straight to a bent and back to a straight condition, i.e. according to the definition, it will also undergo one bending cycle. This bending cycle on a drum, is comparable to a bending cycle on a sheave, for a grooved single layer drum. Tests and practical experience have shown that, a bending cycle on a grooved single layer drum, will cause the same amount of rope fatigue as a bending cycle on a sheave, provided the line pulls and diameters are the same. In both instances, the rope will be bent around smooth, curved surfaces of the same geometry.

**Bending Cycles over Multi-layer Drums**

Where a mine winder rope section travels on and off a grooved multi-layer drum, the rope will also undergo a change from a straight to a bent and back to a straight condition, i.e. according to the definition, it will also undergo a bending cycle. However, the conditions are deemed different. Mine winder rope sections, spooling on the first layer, will be bent around a smooth drum surface however when the second layer is spooled on, the rope will be spooled over the first layer, compressing and damaging the upper rope crown by the second mine rope layer. Mine winder rope sections, spooling on the second and additional layers, will be damaged across the mine winder circumference: initially, the rope will be damaged during the contact with the neighbouring rope wrap, when entering the drum, then bent over a rough surface, created by the previous rope layer, leading to crown wire damage. The same section of rope is then damaged by the following wrap, due to fleet angle contact, leading to additional damage. Finally, the following rope layer will damage the rope section at the side or, if looking at a crossover zone, on the top of the rope.
It is obvious that these sections of rope will be damaged, significantly more than by a single bend, on a single layer drum. Where the system has a multi-layer drum, each bend on the drum will be as much as 4 to 40 times as detrimental to useful rope life, compared to a single layer drum or a sheave. Spooling on a multi-layer drum, has the effect of constant hammering of one rough rope surface against another rough surface, of the same rope.

**The Reverse Bending Cycle**

Test comparison results(s) observed, of bend fatigue test(s) of simple bending cycles and bend fatigue tests with reverse bending cycles, have led to the presumption that a reverse bending cycle would damage a mine winder wire rope, twice as much as a simple bending cycle. Therefore, DIN 15020 stipulates that one reverse bending cycle should be counted as two simple bending cycles. Further investigations, under differing conditions, however, suggest that the damaging influence of the reverse bending cycle(s) vary under changes in the winding system. For example; the relative reduction in the useful service life of a wire, caused by a reverse bend cycle, is directly influenced by sheave diameter(s) and tensile load(s).

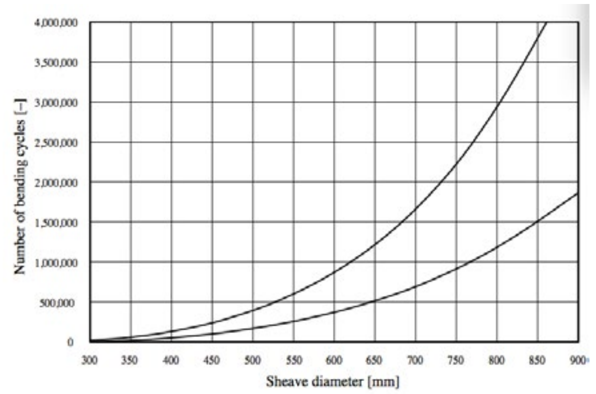
Research by Casar confirms that a reverse bend cycle, in most instances, will influence mine winder ropes useful service life and the resultant damage factor effect, reducing useful service life by between 2 to 7 times, compared with a simple bending cycle system.

**Tension-tension Stresses**

A mine winder rope does not only fatigue as a result of bending cycles, running over sheaves or, drums, but also due to repeated changes in tensile load. Therefore, even an idle/static rope that never runs over a sheave, for instance, the suspension rope of a crane jib, has a finite useful service life, which is several times greater than the useful service life of the running ropes, of the same installation. Before and after mine winder rope(s) run over sheaves, change in tensile load occurs. Provided the number of bending cycles is great and the damage to the rope caused by the change(s) of the tensile load is at least one magnitude smaller than the damage caused by the bending cycles, the influence of the change(s) in tensile load, on the useful service life of a running mine winder rope can be negated.
A mine winder rope's resistance to fatigue increases with the increasing number of and decreasing diameter of the crown wires of a mine winder rope. This improvement is associated with a reduction in the mine winder rope's resistance to plastic wear, due to the smaller crown wire diameter(s). An increase in the number of strands within a mine winder rope significantly contributes to improving a mine winder rope's flexibility and resultantly, the mine winder rope's resistance to fatigue. Mine winder ropes endurance can be increased, by increasing the sheave and/or drum diameter or, by reducing the tensile load the rope is subjected to.

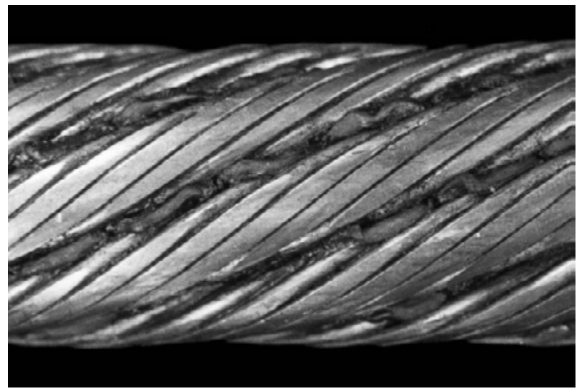
**D:d Ratio**

The influence of the D:d ratio (ratio; drum diameter to nominal rope diameter) contributing to the damage of a mine winder rope, suggests that, the mine winder rope damage increases considerably, with a decrease in D:d ratio. Where all operating parameters are unchanged, an increase in drum/sheave diameter of 25%, could result in a mine winder rope useful service life improvement, of up to 100%.




Effect of the drum/sheave diameter on mine winder rope useful service life

**Wear**



Abrasive/Mechanical wear

Mechanical wear, evident in mine winder rope(s), is the resultant removal of material, due to mechanical abrasion. Mechanical wear against sheaves, drums, or neighbouring rope wraps, will result in the rope diameter initially reducing at an accelerated rate. Due to increasing mechanical wear, the bearing surface of the rope will increase, as the relatively small contact area on the surface of the outer wire is worn to expose a much larger contact surface and the rate of rope diameter reduction will diminish correspondingly. Provided the rate of diameter reduction, due to mechanical wear, is higher than the fatigue crack propagation rate, mine winder rope(s) will not develop fatigue wire breaks. Once the rate of diameter reduction diminishes, fatigue breaks appear. Mechanical wear must not be confused with plastic wear. Plastic wear is the deformation and displacement of material (with or, without cross-sectional steel area loss). Lubrication plays a significant role in reducing mechanical wear. Mechanical wear on multi-layer drums can be reduced by selecting a suitable mine winder rope architecture/design. For example; a mine winder rope with Lang's lay construction and compacted outer strands, will result in a mine winder rope with significantly improved mechanical wear characteristics. Compacted strands are initially stranded in the same way as conventional strands but, are subsequently drawn through a die tool or, in the case of Casar, compaction rollers, to reduce the strand's diameter, smoothen its surface and flatten the line of contact between individual wires.

**Torque/Rope Spin**

Mine winder rope(s) generate torque when subjected to a tensile load. The magnitude of the torque is a function of the helix geometry of the mine winder rope construction. In the instance of a drum winder, it has been established that the angle of lay, in the various mine winder rope elements, decreases linearly with the distance from the cage(s) but, does not vary during the wind. These variations increase with the depth of the winding installation

To seek a condition of uniform torque in the presence of a significant tension gradient, geometric changes occur within the rope structure, which alters the torque characteristics. Measurements of such a mine winder hoist rope reveal that the lay length of the rope near the head sheave is longer than that of the as-manufactured mine winder rope, in contrast to the lay length of the mine winder rope adjacent to the skip, being shorter. The increase in lay length near the top of the shaft reduces the torque, while the decrease in lay length at the bottom of the shaft increases the torque. The extent to which lay length(s) change(s) occur, as the mine winder rope seeks a uniform torque condition, is a function of the length of the mine winder rope suspended in the shaft. The mine winder rope achieves these changes in lay length, through a rotation of the suspended section, notwithstanding rotation is prevented at each end. The maximum rotation occurs approximately at the mid-span, between the head sheave and the conveyance, once equilibrium is reached.

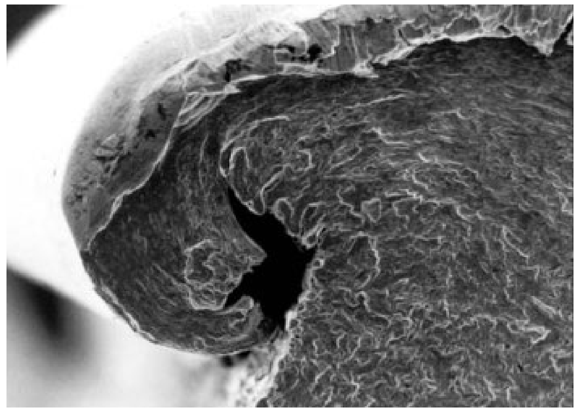
The term "equilibrium" refers to a condition of constant torque in the vertically suspended mine winder rope section. It is evident that, if the load in the mine winder rope changes, then the induced torque will change. The suspended section of mine winder rope has no externally applied torque(s) therefore the torque is constant. This can only be achieved by a variation in twist along the length. The torsional behavior of Lang's lay mine winder rope(s), will limit their application in ultra-deep (2.500 m – 4.000 m) single lift shafts. However, these mine winder ropes have traditionally been used on the majority of drum winding systems, globally. Suspended mine winder rope length, diameter, manufactured lay length, deliberate loss in rotation, and rope weight per unit length, are regarded as being the most important factors relating to the torsional behavior of Lang's lay mine winder ropes.

The purpose of understanding a mine winder rope's behavior, as a result of induced torque, is to provide for appropriate/correct selection and design of a specific mine winder rope construction.

In the instance of a Blair Multi-Rope (BMR) double drum winder, two ropes are applied on either side of the conventional double drum machine/winder. The drum is divided into two sections/compartments so that, each mine winder rope is coiled on one half of the drum winder. Rope tension compensation can be achieved through a conveyance mounted compensating sheave, to which both mine winder ropes, in a compartment, are connected. Alternatively, the headgear sheaves can be mounted on interconnected hydraulic cylinders, to achieve the same effect. Maintaining equal pressure in the cylinders results in automatic adjustment for differences in mine winder rope length(s), ensuring equal mine winder rope tension(s). The main advantage is that 2 (two) mine winder ropes are applied to share the payload and subsequently, resulting in a decrease in mine winder rope diameter. Smaller diameter mine winder ropes are less prone to lay length changes than the larger diameter(s). However, care must be taken to limit the maximum number of layers on the drum, due to the typical narrower drum width, and the maximum allowable fleet angles.

The possible existence of a transition depth, for a particular mine winder rope construction and diameter, where a rope may no longer be suitable due to its torsional response, is well documented.

In successful mine winder applications, the splice/termination end is shorter than a 20 percent decrease from nominal and none of the lay lengths exceeded a 70 percent increase at the sheave end. Short lay lengths, at the splice/termination end (≤ 20%) results in that portion of the mine winder rope being prone to distortion, in the form of kinks and corkscrews. These distortions are the reason for immediate discard and it is accepted practice that, the splice/termination end lay length, should not be operated at more than 20 percent shortening from nominal. Casar mine winder rope(s) can be manufactured with a variable lay length, to compensate and subsequently reduce the induced torque and subsequent premature failure, of such a mine winder rope.



Plastic Deformation

**Contact Stresses on the Outer Surface of the Rope**

Mine winder ropes show an even wear pattern around their circumference, which is a result of rotation due to variations in applied loads as well as dynamic effects. Each time a section of a mine winder rope passes over the sheave wheel and onto the winding drum, it does so with different contact points. The overall process of mine winder rope degradation results primarily from the interaction of plastic wear/deformation and subsequent fatigue of the crown wires. It is further complicated by the effects of torsional deformations, which are inevitable in any application involving long mine winder ropes, with fluctuating loads. With systems utilizing multi-layer spooling, the expected plastic deformation and subsequent fatigue failure are considered to be the main influencing factor considered in mine winder rope useful service life prediction, rope selection, and rope maintenance regime(s).

**Radial Drum Crushing**

This is specifically applicable to the deterioration of mine winder ropes on multi-layer drums. Of interest, are the effects of radial crushing pressure and cyclic changes in mine winder rope loads, on mine winder rope damage accumulation at the parallel grooved half turn and layer cross-over areas. It is known that no mine winder rope will be left in service long enough to reach a point where the mine winder rope will fail due to fatigue, caused singularly by bending cycles. There are several factors that lead to localised damage, typically at the cross-over regions and acceleration regions, where accelerated damage and deterioration occur. Thus, in all instances, the bending fatigue calculation(s) is of lesser importance, when compared to the effect of damage caused to the mine winder rope, by external mechanical elements.

Rope radial and axial loads on multi-layer drums can be determined more accurately where the rope radial stiffness and drum construction details are taken into account. Changes in mine winder rope geometry, during spooling (diameter and length) can decrease the overall radial pressure and tension experienced by the mine winder rope sections, already on the drum.

Other investigations have considered the exact effect(s) of mine winder rope maintenance practices, drum groove dimensions, groove pitching, and filler positions and sizes, on mine winder rope coiling behavior and damage in service for deep mining double drum and Blair multi-rope (BMR) hoists.

The method applied in Rebel's paper, to calculate the nominal radial crushing pressure on the drum (and hence bottom rope layer) is based on the more conservative approach and results in higher nominal crushing loads on the drum, as the method is devoid of dimensional change(s). Casar has developed a matrix to compare the influence of radial crushing, based on the findings presented by Rebel. The results obtained during these comparisons are taken into account during mine winder rope selection, considering the effect of cyclic rope load combined with the radial pressure(s). The selection process also considers the effect of increased mine winder rope surface area on mine winder rope damage, through the reduction of radial crushing pressure. Operational experience has proven a direct correlation between the magnitude of the damage factor(s), the rate of rope deterioration, and required maintenance frequency. A higher magnitude of damage factor will result in reduced useful service life or, necessitate an increase in rope maintenance frequency requirement(s).

**Calculation of Nominal Radial Crushing Pressure on the Drum**

Applying the simple radial load summation approach and taking the worst case that all layers of the mine winder rope on the drum, are subjected to the same axial load, equal to the maximum mine winder rope load in the system, the equation(s) provides a result for the radial contact load per unit length and contact pressure, seen by the bottom rope layer on the winder drum, at the half turn cross-over regions (as per Equation 1).

The total radial rope load per unit length is:

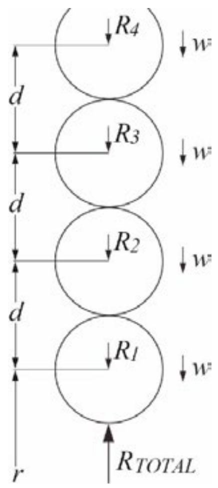


Figure 7: Rope geometry at the cross over(s)

$$R_{TOTAL} = R_1 + R_2 + R_3 + R_4 + 4*w \qquad (1)$$

where: w = rope weight per unit length (kN/m)

It can be shown (van Zyl 2000) that for small rope contact angles on the drum

where: $R_n = F_n / r_n$

R; = radial rope load per unit length (kN)
F; = axial rope load (kN)
rn = drum radius for the given rope layer (m)
n = rope layer number on the drum

Therefore, and assuming that F; is constant for all rope layers, i.e. simply maximum rope load F [kN], Equation (1) can be rewritten as:

$$R_{TOTAL} = F/(r+0 * d) + F/(r+ 1 * d) + F/(r+2 * d) + F/(r+3 * d) + ... + F/(r+(n-1) * d) + n * w$$

Rearranging for n rope layers on the drum gives:

$$R_{TOTAL} = F*\sum_{i=1}^{n} [1/(r+(i-1)*d)])+n*w \qquad (2)$$

where:
d = rope diameter (m)

From the total radial rope load per unit length, the total nominal pressure PTOTAL (as seen by the bottom rope layer and the drum) can be determined using Equation (2) assuming that the radial rope load is applied equally over the full projected contact area (as when calculating sheave nominal tread pressures)

$$P_{TOTAL} = ( R_{TOTAL} * 1.000 )/( 1 * d ) \qquad (3)$$

The values obtained, will in all instances be significantly higher than the nominal tread pressure of 3.5 MPa that is recommended for headgear mounted sheaves for drum winder systems (Wainwright 1995). It is thus considered a more accurate method of comparing expected mine winder rope degradation rate(s), caused by radial pressure, than the traditional calculation(s), devoid of the effect of multiple layers on a winder drum. The wide variation in radial pressure on the drum(s), leads to different rates of deterioration of the mine winder ropes and it is, therefore, crucial to consider radial pressure issues, before selecting a mine winder rope for a particular drum winder installation. Different rope constructions will have varying resistance to high radial pressure loading at the drum cross-over points.

**Influence of Cyclic Rope Load Combined with Radial Crushing**

Studies have shown that it is the combination of radial pressure on the winder drum and relative axial movement of the mine winder rope cross-sections that lead to the plastic wear of the outer/crown wires and subsequent crown wire failure(s) at the half turn and layer crossover areas on the winder drum (Chaplin 1993). The concept of back-slip is particularly relevant to drum rock winders, where the ropes are wound onto the drums, under high tension and unwound, under a low tension i.e. hoisting a full skip up the shaft and then lowering an empty skip down the shaft. This results in the mine winder ropes slipping back on themselves as they leave the drum under a lower tension than initially wound on.

At the half-turn crossover areas, the mine winder rope cross-section(s) are directly above one another as depicted in Figure 7. This represents the worst possible contact condition(s) between adjacent mine winder rope surfaces. The dead turns on the drum are in a fixed rotational position and are therefore prone to damage at the half turn crossovers, more pronounced when not properly tensioned through doubling down with full skips or, cages. In contrast, the live turns, which are exposed to the same conditions, are not prone to the same severity of damage, due to the torsional response of the mine winder rope(s) in deep mine shafts. This torsional behavior leads to the continuous rotation of the live cross-sections and equal distribution of plastic wear around the live winder rope circumference(s). The dead turns do not rotate, thus impacted and worn in the same position. It is calculated that the damage to the dead turns, is 24 (twenty-four) times more concentrated than compared with the live rope section(s) (i.e. 15 degrees versus a 360-degree distribution of the damage). To be considered is that, differing mine winder rope construction(s) with differences in Modulus of Elasticity (less linear back-slip) and Torque factors (rotational differences), will result in differing levels of plastic and abrasive wear distribution in high-pressure areas.

**Effect of Increased Rope Surface Area on Rope Damage**

Thus far, the total nominal pressure PTOTAL (as experienced by the bottom mine winder rope layer and the drum) is determined using the projected area of 1 (one) meter length, multiplied by the mine winder nominal rope diameter. This approach is devoid of the different actual contact conditions that would apply for differing mine winder rope constructions. A detailed study on the surface condition and fatigue of mine winder ropes suggests that the strand contact areas vary significantly for differing mine winder rope constructions and also between new and worn mine winder rope(s), of the same construction (Nishioka 1966). Applying principles derived from solid mechanics of elastic cylinders in contact and the radial contact load per unit length, like RTOTAL from Equation (3), it is possible to calculate more accurate contact stresses between mine winder rope cross-sections on a multi-layer drum, at the half turn cross-over(s), for a given mine winder rope diameter.

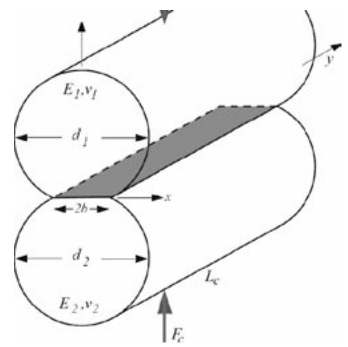


Figure 8: Cylinders in contact

For cylinders in contact as shown in Figure 8, the rectangular area of contact is 2*b*L (Shigley 1986) where b is the half-width of the contact area.

**b= 2* Fe *dc *(1-v2) 1t*Lc*E**

and;
V = V1 = V2 = 0.3 = Poisson's ratio
E = E1 = E2 = 150 GPa = assumed modulus of elasticity
de = d, = d2 = rope contact diameter, dependant on rope construction (m)
Lc = contacting cylinder length (m)
Fc = compressive load applied to the cylinders (N)

The maximum contact stress is defined as (Shigley 1986):

$$P_{MAX} = 2 * Fc/(n: * b * Lc)$$

It is also necessary to consider what the contacting cylinder diameters, de, would be for differing mine winder rope construction(s) applied on mine winder systems. It is apparent from the difference in construction(s) between, for instance, a 6 stranded triangular strand rope and a compacted 8 strand, multi-stranded mine winder rope that, the effective contacting cylinder diameter, de, will be significantly different. The maximum contact stress between differing mine winder rope constructions can subsequently be normalized and multiplied by the percentage payload, to determine an arbitrary damage factor KMAX. It must be noted that the actual value is not the main concern however, the relative magnitude(s) is of importance.

### The Effect of the Factor of Safety and Rope Layers

Given the nominal damage factor, $K_{NOMINAL}$, Rebel investigated how this factor changes for changes in mine winder rope factor of safety and rope layers on the drum, presuming the other parameters are fixed. It is evident from the data evaluated by Vereet and Rebel that, the nominal drum damage factor magnitude varies significantly for changes in design parameter(s). At a higher factor of safety, the effect of adding rope layers on the drum is not as significant as at the lower factors of safety, where each additional rope layer results in a significant increase in the damage factor.

### Nominal Damage Factor

Having established that the in-service damage to mine winder ropes, is dependent on the nominal radial pressure on the drum and the simultaneous change(s) in mine winder rope loading that leads to back-slip, it is possible to define a nominal damage factor, $K_{NOMINAL}$, for the half turn and layer crossover regions. The nominal radial pressure, PTOTAL, is divided by the rope wire tensile grade to remove the units (Pa). The comparison of the relative magnitudes of the drum damage factor(s) is more important than the absolute values and gives an indication of the rope damage/deterioration that can be expected, between different rope installations.

Rebel determined that, if the mine winder rope's self-weight, w, is disregarded and the spooling on the drum is presumed to take place at the average diameter of all the layers, then the nominal damage factor, $K_{NOMINAL}$, can be approximated as follows:

$$= \frac{(20 * n * Payload)/}{(FoS * [(D:d)+n-l] * d^2 * T)}$$

where:

Payload = conveyance payload [kN]

FoS = minimum rope factor of safety for the winding system

D:d = drum to rope diameter ratio for the bottom rope layer on the drum

n = maximum number of layers on the drum

d = nominal diameter of the rope (mm)

T = Tensile grade of the rope (MPa)

This provides a method of calculating the damage factor, directly from the basic mine winder system parameters. The combined effect of all the factors considered, results in a calculation based analysis, referred to as the "Radial Pressure Damage Analysis", which is used to assess the potential for a particular mine winder system to inflict damage on a particular mine winder rope. The higher the "Damage Factor", discussed in the aforementioned paragraphs, the greater the mine winder rope specification required or, the less useful service life to be expected. The same factor is applied in Casar's mine winder rope useful service life prediction model, as opposed to the normal sheave and drum tread pressures, resulting in a more accurate outcome.

## 4. THE MOST COMMON CAUSES OF ROPE FAILURE – FRICTION WINDERS

Given the inherent problems associated with the torsional behavior of Koepe winder head ropes, identified globally in the early nineteen sixties, rope construction(s) recommendations before that, did not discriminate between high torque and low torque (i.e. non-spin) Koepe winder head ropes. The inherent problems associated with the torsional behavior of Koepe winder head ropes were first realised in South Africa after the installation of the first deep shaft Koepe winders at around 1.350 meter depth of wind. Berry and Wainwright

reviewed the application of Koepe winders, during the early nineteen sixties. Conventional 6 (six) stranded triangular Lang's lay ropes, selected as Koepe winder head ropes, for the 1.350 meter depth of wind, resulted in short service lives although, previously, they had performed well at shafts equipped with Koepe winders where the depth of wind(s) was less than 1000m. The initial sets of Koepe winder head ropes at these depths had to be discarded prematurely due to distortion of strands, an outcome of excessive spinning (rotation) of the rope during normal hoisting operations. During the same period, similar problems were experienced at the West Driefontein Mine in South Africa (1.710-meter depth of wind). Following recommendations made my Berry and Wainwright, the ropes were replaced with rotation resistant ropes, and this eliminated the problem and behaved relatively well. Although, the exact reasons for the solution was not fully understood at the time, subsequent research and experience have brought valuable insight and understanding into the behavior of a Koepe winder head rope, and the conditions such a rope need to adapt to. Due to the system in essence being "in balance", irrespective of the position of the conveyances within the shaft, it was wrongly assumed that a given head rope is subjected to a constant load, the only variance being the payload. Also, in the early 1990's, in a study conducted by J Yuassoumis

in South Africa, premature failures of Koepe winder head (rotation- resistant or "non-spin") ropes were attributed, to some extent to the release or built up of torque in the ropes. Release of torque, would loosen the outer and tighten the inner strands and vice versa, a built-up of torque. This upsets the stress distribution and results in premature rope failure.

To better understand the reasons for the premature failures, the key influencing factors introduced into a Koepe winder head ropes requires analysis. Furthermore, the capability of the different current winder rope construction(s) to withstand these factors and how their inherent deficiencies can be addressed, is reviewed and briefly presented in this document.

## Key Influencing Factors

The main contributing factors to the degradation of a Koepe winder head rope can be summarised as follows;

### Bending Fatigue

During winding over a sheave or drum, any rope is required to adjust to allow for the rope to be curved around a drum or a sheave. This causes relative movement between the elements, as well as a fluctuation in loads. Any rope installed on any given application has a finite rope life, and will eventually fail, irrespective of loading conditions and/or depth. Where the applications are such that, no other influences exist that will affect rope life, the rope is expected to fail due to bending fatigue and as such, the life achieved can be considered the optimum for a given rope design. Different rope designs have different bending fatigue resistance levels, but where a certain rope design might be more resistant to bending fatigue, it might be more susceptible to other forms of deterioration. For instance, a rotation resistant rope will have circa ½ the bending fatigue life of a non-rotation resistant rope, but where rotations in a non-rotation rope are excessive, the rope might fail due to contact stresses between the strands and/or distortion of the strands, long before reaching even ½ bending fatigue life. For this reason, all factors and the effect thereof need to be considered, on any given rope design and for a specific application, to determine the most significant contributing factor towards rope failure, to aid in selecting the optimum rope design best suited to provide the optimum performance for the given operational parameters.

### Complete Reversal of Loads

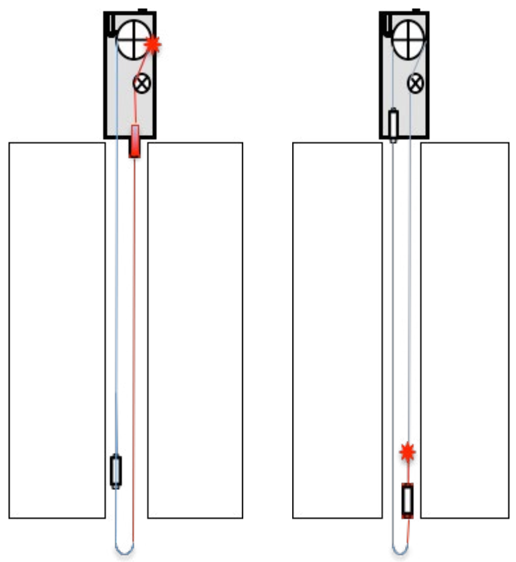
During normal winding, each length of rope is subjected to a complete reversal in applied load. A section of rope, located near the back end in one compartment and thus subjected to an increase in lay-length after loading, could be located near the front end and a subsequent decrease in lay-length after loading when the position of the conveyances in the shaft is reversed (opposite compartment).

### Different Levels of Load/Torque

One of the main factors overlooked and only really identified in the '80s, as most engineers assume the winding system is in balance or very near to it. When considering a single section of the rope during a normal wind, the load experienced by this section of head rope will vary as the conveyance travels up or down the shaft. The reason is the constant increase in tail rope weight (conveyance traveling up the shaft) or vice versa. For instance, a section of head rope just above the conveyance will only be subjected to the conveyance mass and payload and very little tail rope weight at the loading station. Near the top of the shaft, that same section of rope will now still be subjected to all the loads listed above, as well as the added tail rope weight, which is continuously changing throughout the length of wind, therefore the rope head rope needs to adjust continuously to reach equilibrium. This variation in load induces rotation in the rope and can be observed during normal winding. It must also be noted here that, it goes without saying that irrespective of rope design, this variation in load and therefore rotation, can be reduced by decreasing the weight of the tail rope(s). Of course, there are limitations as the maximum out of balance weight to achieve an acceptable T1/T2 ratio. The maximum out of balance load the hoist is capable of lifting, also needs to be considered.

**Sudden Changes in Load/Torque**
To further complicate the load variations, the rope also needs to be able to adjust to a very different load within a very short time, as the rope passes over the drive sheave of the Koepe winder. In such an instance, the payload is immediately removed and the rope could also be subjected to much different suspended tail and head rope weights. This is further complicated when this section of the rope passing over the drive sheave is also subjected to acceleration or deceleration forces. This sudden reversal in loads results in elements in the rope having to continuously adjust rapidly to achieve an equilibrium in induced torque during winding. It should also be mentioned that the rope will also "creep" in relation to the drive sheave inserts, due to the differing loads in the opposing sides of the drive sheaves.

**Load and Torque Increases with Depth of Wind**
As the operating depth of a shaft increases, the suspended load, a function of the weight of the rope(s), increases proportionately. More importantly, the static load range becomes greater as the shaft gets deeper, as the suspended tail rope weight will always be negligible for any depth of wind, near shaft bottom, but increasingly more due to a longer tail rope near the surface, as the shaft gets deeper. As a result, differences between maximum and minimum rope loads increases (static load range), therefore resultant behavior and more specifically the number of rotations induced in the rope will increase.

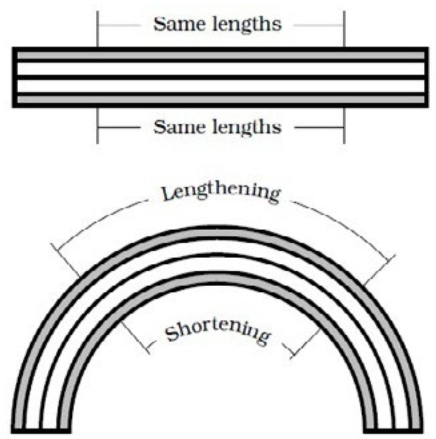


**Friction Driven – Contact Stresses/ Abrasion Cyclic Fatigue**
Being a friction driven winder, the rope is subjected to contact stresses between the drive sheave and outside of the rope. Although not a major factor, this can cause abrasive wear and loss in material on the outside of the rope, and therefore a reduced rope life.
**Corrosion**
A Koepe rope is required to operate in harsh operational environments and corrosion should be a factor to consider, potentially contributing to premature failure. Both the surface finish and the lubrication regime of the rope can be adjusted to determine the most cost-effective means to achieve optimum service life.



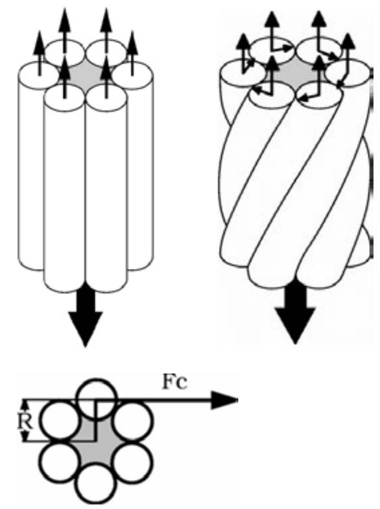
## The Effect of Variations in Load

From the contributing factors listed, it is observed that, the most significant influencing factor to consider, is the behavior of the rope when subjected to significant load variations. In short, the most obvious parameters that could influence rope life other than bending cycles, can be listed as:
- Sudden changes in load, due to cyclic winding and loading;
- Continuous changes in load, due to winding,
- Increased differences in maximum and minimum loads at greater depths of wind.




Now that the sources of possible fluctuations in rope loads have been identified, the effect of such fluctuations needs to be considered.

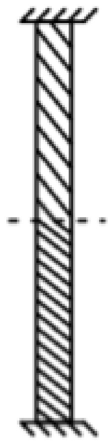
To allow for any rope to be able to be bent around a sheave or a drum, the strands in such a rope must be laid up in a helical pattern. However, with the advantage to be able to be bent around an object also comes a secondary effect. When an axial load is applied to a rope, the following changes occur;
- The helical shape will create a tangential force at a distance from the neutral axis
- Tangential force at a distance results in torque
- The total of the products of the tangential forces and their distances from the neutral axis, determine the moment of a rope.




The helically formed strands of a wire rope under tensile load, tend to unwind. Therefore a rope specimen under tensile load with its two ends restricted from rotating, relative to each another, develops torque. The torque induced is a function of the tensile load applied to the rope and the relative rotation introduced between the two ends of the specimen, before the application of the tensile load
- The amount of torque and resultant moment will determine the amount of rotation that will result.
- This amount of rotation is directly proportional to rope life as the amount of rotation will determine the amount by which the elements within the rope have to adjust to, and the subsequent degradation of the elements within.

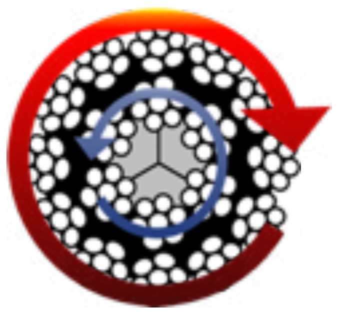
Further to the torque that results from loading and load variations, some other external conditions can also contribute to enhancing detrimental conditions;
- Misalignment of sheaves and/or deflection sheaves
- Incorrect procedure during installation, related to reeving and/or serving.
- Incorrect groove diameters
- Differences in drum tread lengths

**Load Sharing Mechanism in Multi-layer Traditional Non-spin Ropes**



The fundamental principle of rotation-resistant ropes is that an independent wire rope core (IWRC) is covered with an outer strand layer, closed in the opposite direction. Torque will be equal in the opposing layers, once equilibrium is reached. The non-linear shape of the torque-tension curves of (traditional) non-spin or rotation resistant ropes, is a result of uneven distribution of the tensile load between inner and outer strands. With negative end rotation, the inner strands carry a greater proportion of the tensile load than the outer strands. The resulting torque is therefore negative. For positive end rotation, the outer strands will carry a greater proportion of the tensile load. The resulting torque is therefore positive. Once equilibrium is reached, torque in the opposing layers is equal, but not the stresses. The reason being, the difference in the cross-sectional steel area of the opposing layers and the differences in distances, from the neutral axis.
When considering the example herewith, 12 outer strands will counter 6 inner strands at double the radius of the inner strands. The sum of the moments will thus be;

$$(12\,Fc * 2R) - (6\,Fc * R) = 18Fc * R$$

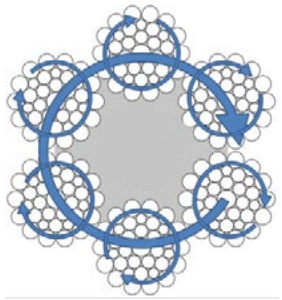


With such a high residual moment, significant rotation can be expected, even though the rope is classified as a rotation resistant rope. The use of these rotation-resistant or "non-spin" wire ropes, constructed with more than one layer of strands, wound in opposite directions, is the common practice on friction winders around the globe, serving deeper depth of wind shafts.

## Summary of Attributes – Basic Rope Construction Spectrum

As a means to compare the different ropes installed on Koepe winders, the specific attributes of a Round Strand, Full Locked Coil and a 34 LR (Low Rotation) has been briefly explained.

**6-Strand Conventional Design (6x36FC)**

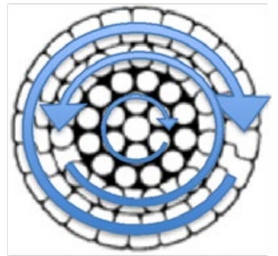


6 Strand Conventional

When torque is introduced (or let out), the following changes occur in a non-rotation resistant rope; Non-rotation resistant rope will rotate and find equilibrium, by lengthening and shortening of the lay length, along the length of rope (ends are fixed) Shortened lay length, causes overstressing and failure between strands, at greater depths of wind (low torque resistance, high spin factor), and possible distortion of the strands where the lay length is increased to the level that, the rope is unable to remain stable when wound over a drum or sheave. Due to the low steel density, significant stretch and variations in lay length (a direct result of induced rotations) is a limiting factor at deeper lengths of wind.

**Full Locked Coil**

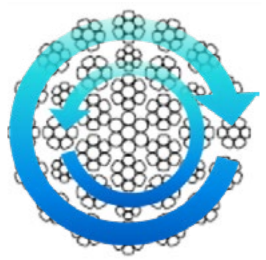
The Full Locked Coil rotation resistant rope will find equilibrium, by shortening and lengthening of opposing layers of wire (high torque resistance, limited rotation). The sum of the forces and stresses in opposing layers will be equal if, the product of the steel cross-section and radii, is equal. Although this rope is considered a low rotational rope, the low torque factor is achieved by several single layers of wire, closed in the opposite direction, relative to each other. This results in many elements, constantly adjusting and scuffing against each other, whilst the rope reaches equilibrium between the opposing layers (torque). From a rotation property, this rope is considered very effective but, it is well known that once the relative movement between opposing layers becomes compromised, the rope is unable to adjust to load variations, and waviness will result, which leads to premature failure. This phenomenon was reported and published by the UK Coal board in the 1960s and especially prevalent in rope diameters exceeding 42mm.



Full Locked Coil

**34 Strand Low Rotation**

The 34x7 to 24x17 rope designs will find equilibrium, by shortening and lengthening of the opposing layers (high torque resistance, low spin factor). Once reached, the torque in opposing layers will be equal but, not the stresses (different steel cross-section and radii). A significant improvement but induced rotation not as limited as the full lock coil. Stresses between individual strands will not be equal, due to different lay lengths of the individual strand(s) (unequal lay) and the moment not being zero (some positive rotation is still present at depth) High stresses between the opposing layers remain a significant factor, as positive rotation does allow for an increase in contact pressure between opposing layers.



34 Low Rotation

## How do Koepe Head Ropes Fail?

To enable the design or selection of a suitable winding head rope for a Koepe winder, the typical modes of failure must be considered. As an outcome, the following attributes can be listed, as key, to be taken into account during the design of a Koepe Head Rope;

- The maximum variation in load range is determined by the depth of the shaft, the installed tail rope weight, and payload.
- This maximum variation is expressed as a percentage of the minimum breaking force of the head rope (static load range)
- The greater the static load range, the greater the torque induced and the greater the rotations induced.
- The magnitude of this static load range, and the resulting induced rotations for a given rope design, is directly proportional to rope life.
- Therefore, a higher breaking load and lighter tail ropes will improve the service life
- A non-rotation resistant rope offers a better fatigue service life up to a certain static load range (shaft depth)
- Where the static load range is such that it will result in significant rope rotations, a rotation resistant rope is required and at significant depth, a rope with the minimum amount of rotations will provide for the best possible service life
- For very deep shafts, the optimum rope life will be obtained if the rope has a near Zero/Low Torque Factor (Sum of moments = 0)
- It is recommended that the static load range be kept below 11.5% to ensure an acceptable rope life.

To further optimise rope performance the following needs to apply;

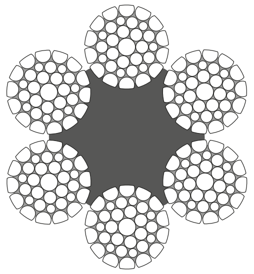
- Must have a High Tensile Strength, to achieve a higher Factor of Safety and therefore lower static load range as a percentage of the breaking strength.
- A High Breaking Force to Mass Ratio – Better Safety factor equates to better Rope Life
- Flexible – Resistant to Fatigue
- Resistant to External Contact Stresses (Tread pressures) and Abrasive Wear

- Maintain Integrity of Construction during Installation
- Resistant to Externally Induced Torque
- Shock Load Resistant
- Resistant to Stresses between Opposing Layers
- Resistant to Stresses within Individual Strands
- Torque and Rotation properties must remain uncompromised for the life of the rope
- Lubricated, lubrication to be maintained

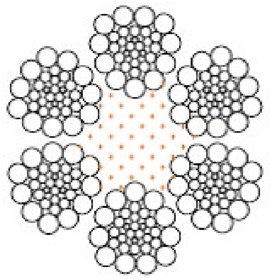
As noted, premature failure of Koepe winder head ropes can be attributed for the most part, to the release of or torque built up in the ropes. The build-up of torque can overstress strands and also, the sudden release of the same torque can jeopardise strand stability. With a typical rotation resistant rope, the release of, or positive torque would loosen the outer strand and tighten the inner ones. This could upset the stress distribution and results in premature rope failure. An increase or negative torque will tighten the outer strands, causing an increase in contact pressures between opposing layers. The non-linear torque-tension curves were also identified as a reason why the stresses between the inner and outer strands were unbalanced. The varying levels of torque present in a Koepe winder head rope will manifest themselves, through rotation. This is proof that, the rope is continuously attempting to reach a state of equilibrium. With traditional non-spin ropes, these stresses can never become equal, due to the differences in effective cross-sectional steel area and the radii at which these forces are located in the rope. In a non-rotation resistant rope, distortion of the rope's geometry will occur, and excessive rotation and/or movement observed. Also, traditional non-spin ropes exhibit significant damage between the inner and outer strands, due to contact stresses between these elements and subsequent failure of the inner wires, these failures are common and difficult to detect during non-destructive testing.

## 5. TRADITIONAL ROPE SOLUTIONS

At present, the most common traditional rope designs installed on friction winders globally, can be summarised as follows (although there might be some exceptions, these are the most common);



6 Strand Conventional



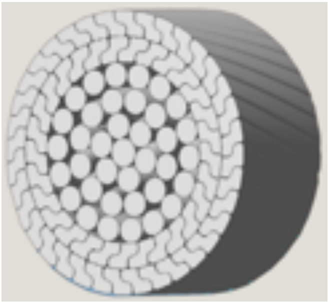
6 Stranded Triangular Strand ropes

### Advantages

- Relatively cheap
- Readily available from most rope manufacturers
- Round stranded product can be in the compacted or non-compacted form
- Mediocre bending fatigue performance
- Fairly flexible and easy to handle
- No contact between opposing directions of lay

### Disadvantages

- Construction not very stable
- Very low resistance to fatigue
- In certain designs, the length of lay within the strands will differ, resulting in high-stress contact points between wires.
- Will find equilibrium by significant rotation until opposing torque between the tightening of the outer strands near the front end, and loosening of the strands near the back end becomes equal.
- Very high spin factor/rotation
- Outer strands might fail due to distortion (back end) or high contact stresses between outer strands (near the front end)
- Acceptable rope life only achievable at shafts with very low static load ranges



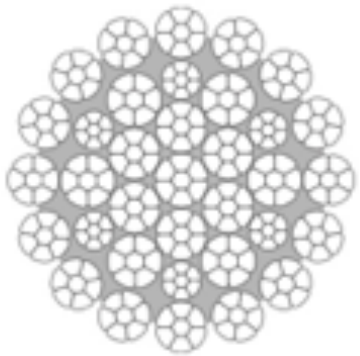
Full Lock Coil

### Advantages

- size for size they are of greater strength than stranded ropes, in the same tensile grade
- the smooth external surface provides greater resistance to wear, due to abrasion
- They will find equilibrium by shortening or lengthening of the opposing directions of lay
- they have excellent rotation resistant properties with minimal rotation (near zero)
- the elastic and permanent stretch is less than that of stranded ropes (can also be a disadvantage as drum groove tread lengths need very accurate maintenance)
- they can operate under higher radial pressures than any other rope construction(s);

### Disadvantages

- Only one layer of wires, representing between 18% and 40% of the total length of all wire in the rope (depending upon the rope size and construction) is visible
- A significant number of layers closed in the opposite direction of lay, might be required to obtain the low torque factor/low rotation (depending on rope diameter)
- Locked Coil ropes are less flexible than other rope constructions. To ensure extended service, the rope should not be bent sharply and should work on drums and pulleys, where diameters are significantly larger than the minimum required for a multi-stranded rope.
- During service, Locked Coil ropes, generally over 42 mm diameter, may develop a wavy or spiral form instead of remaining straight, mainly caused by fretting corrosion.
- Locked Coil ropes should have no more layers of shaped wires than are necessary, as incremental layers further increase the probability of experiencing problems with waviness.
- They have a low breaking force to weight ratio
- Maintaining integrity of construction during installation is very difficult
- The close fitting wires leave little space for lubricant and post installation lubrication is not very effective



34 Low Rotation

### Advantages

- Simple construction, readily available from most suppliers
- Strands can be compacted
- Will find equilibrium by shortening/lengthening of the opposing directions of lay
- Low spin factor (Positive)
- Good resistance against fatigue
- Fairly easy to maintain the integrity of construction during installation
- Post-installation lubrication effective for outer strands
- More stretch than a FLC, which allows for more tolerance on drum groove tread length maintenance

### Disadvantages

- Strand design limited to 7(6/1) which will result in lower fatigue resistance for bigger diameter ropes
- High contact stresses between opposing layers when outer strands are tightened.
- High contact stresses between adjacent strands in the same directions of lay, when relevant lay lengths are shortened.

- Outer strands might become loose (birdcage) or the inner strands might protrude between the outer strands, where excessive rotation is experienced. (due to operating parameters or external induced rotation)
- The Center strand contains a single "King wire" which will have to be overstretched in areas along the rope where lay length is increased (straight line component inside a helix)
- Lubrication cannot be maintained for the life of rope, within the inner components

## Conclusion

Although a friction winder system in designed to be nearly in balance, the load experienced by the friction head rope is constantly changing, due to the change in suspended tail rope length, as the conveyance travels within the shaft. For deeper lengths of wind premature failures of Koepe winder head ropes (rotation-resistant or "non-spin") can be attributed, to the release or built up of torque in the ropes, caused by rotation. This rotation is a function of the static load range, or largest variation in load experienced by the head ropes, and there is a direct correlation between the static load range and friction winder head rope life. Static load range is determined by the depth of wind, the breaking force/safety factor of the rope, the payload and the weight of the tail ropes. Release of torque, would loosen the outer and tighten the inner strands and a built-up of torque vice versa. This upsets the stress distribution and results in premature rope failure. Also, the non-linear torque-tension curves were identified as a reason why the stresses between the inner and outer strands were unbalanced. There is evidence that the rope is continuously attempting to reach a state of equilibrium, between the opposing directions of lay, by rotation of the opposing elements, until the opposing torque values are equal. Although the torque in the opposing layers will be equal after equilibrium is reached, the stresses and moments will not necessarily be.

Where the IWRC or inner strands are unable to match the moments present in the outer layer of strands, this will lead to overstressing of the IWRC and potentially cause the outer strands to go slack or, the core to "pop" from within the rope. This effect is worsened exponentially, as the diameter of a rope increases and where an increased number of elements are required to limit rotation. In a full locked coil rope, with a low torque factor and limited spin, the linear and radial movements of these elements are excessive, due to the number of layers required for a given rope diameter, with instances where "waviness" can be expected, which is common for full locked coil ropes, with a greater diameter. With traditional non-spin ropes, the torque induced stresses can never become equal, due to the differences in effective cross-sectional steel area and the radii at which these forces are located in the rope. Traditional non-spin ropes exhibit significant damage between the inner and outer strands, due to contact stresses between these elements and subsequent failure of the inner wires is common and difficult to detect during non-destructive testing.
The solution to the torque related problems will be a rope where the stresses between the outer strands and the IWRC can be kept equal or, as close to equal as possible and induced rotations kept to a minimum. Secondary to.that, is the distribution of contact stresses within the rope elements and fatigue resistant properties.

# 6. KEY ROPE DESIGN ATTRIBUTES TO PREVENT MINE WINDER ROPE FAILURE

## Drum Winders

Multi layered full steel mine winder ropes have enhanced advantages. Low compressibility and the compact structure of the mine winder rope guarantee geometric stability. The higher metallic area of full steel mine winder rope(s), results in a lower specific tension and as a result, lower stresses in individual wires, when subjected to the same loads. In addition, the increased number of outer strands which are compacted and available in a number of parallel lay designs to optimise outer wire diameter are available. This effect underscores an enhanced useful mine winder rope service life. When considering the modes of failure, tried and tested solutions are readily available, to overcome these issues to a great extent, be it crushing, backslip or any other underlying cause;

| Root Cause | Remedy |
|---|---|
| Contact stresses between layers | Plastic layer<br>Same direction or equal lay |
| Contact stresses within individual strands | Equal lay length<br>Adequate lubrication |
| Contact stresses between strands | Plastic layer<br>Compacted strands<br>Adequate support from core |
| Resistance to outer contact stresses | Compacted strands<br>Bigger wires<br>More strands |
| Resistance to induced torque | Correct lay length<br>Flexibility |
| Integrity of construction during installation | Pre-forming<br>Plastic impregnation |
| Resistance to fatigue | More strands/wires – flexibility<br>Higher fill factor – less stress in components |
| Resistance to stress concentrations | Equal lay<br>Bigger wires – more resistance to crushing |
| Resistance to overstressed components | Higher fill factor – less stress in components<br>No "King Wire" within core |
| Resistance to corrosion | Protective film – Galvanising/Bezinal<br>Plastic layer to seal in lubrication |

## Friction Winders

CASAR has for many years investigated the typical friction winder rope designs being applied, and spent a significant amount of resources and focus to identify and develop a remedy to the shortcomings of these rope designs, where it became clear that improvements could be made.

While it might not be exceptionally difficult to improve the performance of any design, the additional costs applicable in the manufacture of such a product, need to be such that the subsequent improvement in rope service life will still result in a more cost-effective solution. The available rope designs for all winding parameters can be optimised to ensure the most cost effective product is supplied. Whether it be a system with lower static load ranges, where a non-rotation resistant rope with inherent improved resistance to fatigue, will outperform a rotation-resistant rope due to the inherent diminished resistance to fatigue, or be it for deeper lengths of wind, where static load range will increase significantly, Casar can provide the optimum solution and currently unmatched performance attributes by any other rope design available to the open market. There are also alternative rope solutions with characteristics that are a compromise between the attributes of the rope solutions mentioned, and typically selected for existing winders where specific weight and breaking forces need to be met.

| Root Cause | Remedy |
|---|---|
| Excessive Rotation | Near zero torque factor<br>Stressed within opposing layers near equal |
| Resistance to externally induced torque | More flexible. Numerous options of number of outer strands and wires to optimise rope performance |
| Contact stresses within individual strands | Equal lay length<br>Adequate lubrication |
| Contact stresses between strands | Plastic layer<br>Compacted strands<br>Adequate support from core |
| Contact stresses between opposing layers | Compacted strands<br>Bigger wires<br>More strands |
| Contact stresses between outer wires and sheave/drum tread material | Compacted strands |
| Integrity of construction during installation | Plastic impregnation/strands locked in place |
| Resistance to fatigue | More strands/wires – flexibility<br>Higher fill factor – less stress in components |
| Resistance to overstressed components | Higher fill factor – less stress in components<br>No „King Wire" within core |
| Resistance to corrosion | Protective film – Galvanising/Bezinal<br>Plastic layer to seal in lubrication |



# 7. ROPE HANDLING AND MAINTENANCE

## Rope Unloading:

Utmost care should be taken during the unloading of reels upon arrival at the mine. If the drum reels have not been equipped with suitable lifting attachment points, it is recommended steel bars be introduced through the holes in the rope reel flanges and these steel bars be suspended by suitable slings to a spreader beam to facilitate off-loading. Under no circumstances should these slings come into contact with the reel flanges. Damage to these flanges could affect the uncoiling of the rope during subsequent installation.


## Rope Storage and Handling

Examine the mine winder rope(s) immediately after delivery to check its identification and condition and verify that, the mine winder rope is in accordance with the details on the Certificates and/or other relevant document(s).

Check the mine winder rope(s) diameter and examine any rope termination(s) to ensure that, they are compatible with the equipment or machinery to which they are to be fitted.

Supplied mine winder rope(s) should always be stored in a dry and well ventilated environment. WireCo recommends the use of suitable frames which will keep the reels clear of the ground. Special consideration should be given to the immediate surroundings to ensure the mine winder rope(s) are not exposed to elements which may be harmful. If the mine winder rope(s) need to be stored outside, adequate steps should be taken to protect the rope from the elements.

Examine Mine winder rope(s) in storage periodically and when necessary, apply a suitable dressing, which is compatible with the manufacturing lubricant. Upon completion, re-wrap the mine winder rope(s) unless it is obvious that this will be detrimental to mine winder rope preservation. Failure to apply the correct dressing may render the original manufacturing lubricant ineffective and rope performance may be significantly affected. In addition, it is recommended that the rope be rotated through 180° at intervals not exceeding 6 (six) months, to prevent the excessive migration of lubricant within the rope.

Mine winder rope storage and handling (i.e. before installation) must always be in accordance with generally accepted practice and all reasonable efforts must be made to protect the ropes from mechanical and or environmental damage. Mine winder rope(s) must never be dragged over the ground during maintenance procedures. Each mine winder rope(s) reel must be properly covered to protect the rope against the weather and elements.

## Pre-installation Checks

**Sheaves**

All sheave grooves, including doubling down sheaves, must be checked for proper surface finish and size in accordance with SANS 10294, „Code of practice for the performance, operation, testing and maintenance of drum winders relating to rope safety", available on request from the SABS.

Sheave alignment, with respect to the winder drum, must be in accordance with SANS 10294. Fleeting angles between the rope and any sheave(s) must not exceed 1.50 for plain and 2.00 for grooved drums at any time, either during installation of the rope, maintenance or, permanent operation for conventional mine winder rope(s). Non-spin ropes require a fleeting angle less than 1.50.

Special care should be taken to ensure that, sheave groove diameter(s) are within acceptable limits. WireCo requires that, sheave(s) be cut prior to installation of new mine wind-

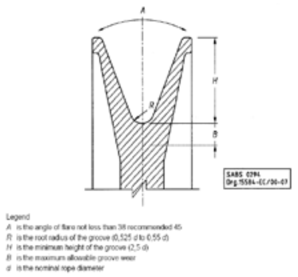
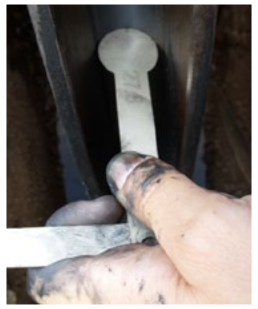


Figure 2 — Dimensions of sheave wheel groove



er rope(s), to ensure that, no undue damage is introduced to the rope and to prevent torque build-up in the rope(s) which may lead to "waviness" and subsequent premature failure.

In accordance with SANS 10294 „The performance, operation, testing and maintenance of drum winders relating to rope safety" a sheave groove diameter recommendation of between 1.05 and 1.10 times the nominal rope diameter is given. (Ref: SANS 10294, Page 12, Figure 2).

Ø MIN = 0.525 x dnom x 2 = + 5 %
Ø Opt = 0.5375 x dnom x 2 = + 7.5 %
Ø MAX = 0.55 x dnom x 2 = + 10%

**Drum Sleeves**

Drum sleeve groove profiles must be inspected and the sleeves must be properly cleaned, eliminating sharp edges before the new WireCo mine winder ropes are installed. It is important that, the drum sleeve grooves conform to the SANS 10294 code, „The performance, operation, testing and maintenance of drum winders relating to rope safety", Annex B recommendation, drum grooves to be 6.0% to 8.0% greater than the nominal mine winder rope diameter. Drum sleeve mounting bolts must not become loose at any point during the service life of the mine winder ropes. The bolts must be checked for tightness before new WireCo mine winder ropes are installed.

**Hawse Hole**

The hawse hole entrance must be properly maintained and clear of rough edges.

**Risers**

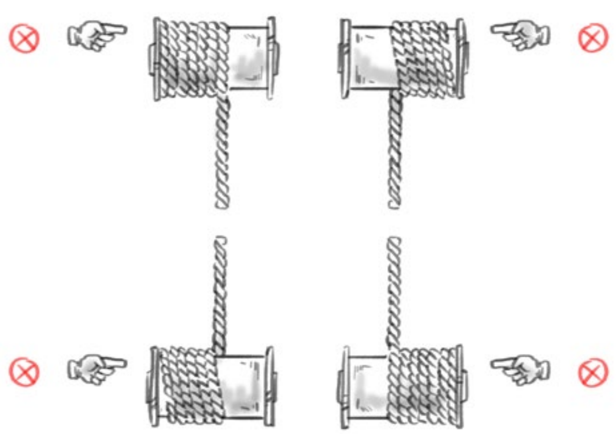
The drum risers must be properly secured and maintained.

**Rope Terminations**

Rope terminations must be made in accordance with the relevant regulations and standards

**Rope Coiling**

One layer spooling: For drums with one layer, the following applies:
right hand drum – left hand rope
left hand drum – right hand rope
Multiple layer spooling: With multiple layer spooling, the direction of spooling changes from layer to layer. So the direction of lay of the rope would also have to be changed from layer to layer. Here, the direction of lay should be chosen for the layer which is working the most:
right hand layer – left hand rope
left hand layer – right hand rope
And here is how you determine the direction of the winding of the drum or reeving system: Place yourself at the fix point (X) of the rope on the drum (at the reeving system) and follow the turns of the rope with your finger.



## Rope Installation

**Rope Installation and Tensioning**

Details of rope installation and rope tensioning procedures (e.g. doubling down) should be discussed and agreed with WireCo, before the procedure(s) are implemented. This is deemed a critical requirement. It includes the transfer of ropes from WireCo mine winder rope reels onto winder installation drums, in the case of Koepe installations, in order to conform to critical fleeting angels.

Handling and installation of the mine winder rope(s) is to be carried out in accordance with a detailed plan and should be supervised by a competent person.
Visual examination of the mine winder rope(s), to ensure that no damage or obvious signs of deterioration, has taken place during storage or transportation to the installation site, is deemed to be critical.
When releasing the outboard end of the mine winder rope from a reel, same is required to be undertaken in a controlled manner. On release of the bindings and servings used for packaging, the mine winder rope is inclined to straighten itself from its previously radiused position. Unless controlled, this could result in a safety crtitical condition, which could cause injury to personnel, assigned to the task.
The new mine winder rope should be installed with adequate tension, especially where there is multi-layer coiling on the winder drum and it is not possible to tension the full length of rope subsequent to installation. This back tension arrangement should preferably be able to provide a tension equal to the normal working tension but, not less than half the normal working tension (the same tension as obtained during normal "doubling down" procedure(s), where the rope termination is secured to the shaft headgear and the conveyance loaded with a fully laden conveyance.). It is critical that, mine winder rope(s) are doubled down on multi-layer drum(s), with full skips or cages, after installation and after each back-end cut, to ensure proper tension on the dead turns on the drum(s). Doubling down should ideally be done to within ½ of a turn of the hawse holes but, at least to within one turn. When using a "doubling down" arrangement, the groove diameter of the doubling down sheave should be no less than 7.5% to 10.0% of the nominal rope diameter, and the d:D ratio no less than 1:32.
Under NO circumstances should torque be introduced into a new mine winder rope during installation. This will occur if the old mine winder rope is used to reeve the new mine winder rope into the system and the rope(s) are attached in a manner which will transfer the torque present in the old mine winder rope into the new rope or, if the sheaves are misaligned. The cause of any such torque should first be eliminated before installation. The use of a swivel that will eliminate the transfer of torque from the old to the new rope is highly recommended.

Mine winder ropes may never be dragged over the ground during installation or, during maintenance procedure(s).
Re-reeling of the ropes on-site, before installation, is not recommended. WireCo recommends that, the mine winder rope(s) are spooled directly onto the winder drum(s) from the reel(s), on which they were supplied.
During the manufacturing process, every mine winder rope is constructed with a preferred bending direction, which is determined during closing. When delivered to the end user, the mine winder rope is delivered in the same condition.
It is deemed imperative that, the rope bends in the same direction when wound from the reel to the winder drum. If the mine winder rope is wound to the bottom of the winder drum (underlay), it should leave the drum from the bottom and must be installed in the same manner (top) to the overlay drum. Thus the ropes are always installed from bottom to bottom, and top to top. Should this procedure not be adhered to, the mine winder rope will twist back between the reel and winder drum, or later try to obtain its preferred position during normal service. In both cases, structural changes will occur, which could lead to premature discard.
Position the reel and stand such that, the fleet angle during installation, is limited to 1.5 degrees. If a loop forms in the mine winder rope ensure that, the loop does not tighten, to form a kink.
Monitor the mine winder rope(s) carefully as it is being pulled into the system and make sure that, the mine winder rope(s) is not obstructed by any part of the structure or, mechanism which may cause the rope to come free. Take particular care and note the manufacturer's instructions when the rope is required to be cut. Apply secure servings on both sides of the cut mark. Ensure that, the length of serving is at least equal to 2 (two) mine winder rope diameters.
When terminating a mine winder rope end, with a wedge socket, ensure that, the mine winder rope tail cannot withdraw through the socket, by securing a clamp to the tail or, by following the manufacturer's instructions. The loop back method uses a rope grip and the loop should be lashed to the live part of rope, by a soft wire serving or, tape, to prevent flexing of the rope in service. The method of looping back should not be used if there is a possibility of interference of the loop with the mechanism or structure.
Failure to secure in accordance with instructions could lead

to loss of the mine winder rope and/or injury.
When coiling a mine winder rope on a plain (or smooth) barrel drum, ensure that, each lap lies tightly against the preceding lap. The application of tension in the mine winder rope significantly assists in the coiling of the mine winder rope. Failure to correctly secure the mine winder rope end correctly is likely to lead to slackness, distortions, premature removal from service and a reduction in the breaking force of the mine winder rope.
Ensure that, any fittings such as clamps or fixtures are clean and undamaged before securing mine winder rope ends.
Make sure that all fittings are secure, in accordance with the OEM's instruction manual or, manufacturer's instructions and take particular note of any specific safety requirements e.g. torque values (and frequency of any re-application of torque).
Check that, the new mine winder rope is spooling correctly on the winder drum and that, no slack or cross laps develop. If necessary, apply as much tension as possible to ensure tight and even coiling, especially on the first layer. Where multi-layer coiling is unavoidable, succeeding layers should coil evenly on the preceding layers of rope.

**Running In**

Rope running in procedures must be conducted in accordance with WireCo recommendations. Where possible, the following running-in procedure is recommended, to allow the ropes to settle in satisfactorily;

- 3 cycles v = 2 m/s after adjustment
- Examination of all rope connections
- 10 cycles = ½ Speed No load = empty skip/conveyance
- 15 cycles = ½ Speed ½ Payload
- 15 cycles = ½ Speed Full skip/Loaded conveyance (Licensed payload)
- 10 cycles = Max. speed Full skip/Loaded conveyance (Licensed payload)
-

## Maintenance Related Issues

A mine winding rope comprises a number of mechanical elements, required to work in unison without any undue compromise of the integrity of any of the elements. For this reason, maintenance practices will be similar for all multi-layered spooled winders, irrespective of rope construction, duty (Man or Rock) or design of rope (six stranded triangular or multi-stranded high performance ropes.
Cutting of WireCo mine winder rope(s) with a blow torch, is strictly prohibited. WireCo recommends the use of a frame mounted cross-cut angle grinder.
Arc welding or flame cutting of a WireCo steel reel, while the new rope is on the reel, is strictly prohibited. If steel fittings need to be attached to the reels for rope changing procedure(s), the details and method of attachment needs to be agreed in advance between the mine and WireCo.
To prevent inadvertent damage, it is recommended that, the following point(s) be adhered to during normal operational maintenance;

- No spikes to be placed into the rope.
- No puncturing of the plastic in-lay layer may be allowed, at any time (applicable to multi-stranded high performance mine winder ropes).
- No inducing of spin/rotation or, spin/rotation out, of the mine winder rope(s), unless agreed to in advance with WireCo. Detachment of the mine winder rope(s) during normal re-making of end-termination(s), does not constitute inducing spin out however is deemed a normal operational procedure.
- During the re-making of end-terminations, care is to be applied, not to allow the rope to un-lay, as this may result in the fiber or steel core being overloaded. (Serving wire is to be applied prior to cutting of the front- ends)
- No „end for ending" of TURBOPLAST, DUROPLAST multi-stranded high performance mine winder ropes or Triangular stranded ropes is permissible.
- Proper operation of rope load compensation systems for BMR winders must be maintained, at all times.
- Proper operation of conveyance holding devices (i.e. onto the shaft guides) when fitted, must be maintained, at all times.
- No slack rope is allowed under normal operating conditions.
- The mine must only use WireCo approved cleaning and degreasing agents, on WireCo mine winder rope(s). The use of inappropriate agents, e.g. trichloroethylene or paraffin/kerosene, can cause severe damage to the internal fiber or plastic in-lay core.

## Lubrication

It is recommended that the mine apply CASAR recommended lubricants for in-service lubrication. The frequency of rope re-lubrication must be agreed between the mine and CASAR and should be applied according to good maintenance practice. The method of applying rope lubrication is at the mine's discretion, however, CASAR recommend automatic lubrication systems which are based on lubrication dosing according to the number of cycles done by the rope. Due to the primary lube, it is suggested to apply a suitable in service lubricant, which contains solvent that evaporates after application. It Builds a sticky but elastic layer on the rope surface. It's applicable with pressure device (Masto, Viper kit) or manually.

**Application Amount:**

Lubricant amount [in kg] = (3.14 * rope diameter [in m] * rope length [in m] * required lubricant amount [in kg je m²]) + general loss (app. 10-20 %). It is calculated an optimal lubricant amount of 0.075 kg/m²* 2 (due to the containing amount of solvent 50%).
Due to the rope parts which are outside and due to the temperature, it is recommended a very small layer on the surface. Too much lubricant causes fling off in winter. In summer it can create dripping problems.

**General Procedure:**

The maintenance cycles depend on the area and usage of the ropes, working conditions at site (aggressive atmosphere, wet shaft etc.), climate and weather conditions. It has to be monitored from the mining operators. The rope should be cleaned and dry before starting the relubrication action.

- Monitoring (monthly)
- By facing rust spots on the rope surface or in between the gaps – starting cleaning and maintenance.
- The same cause by missing lubricant in or on the rope. Later one can extend the monitoring periods (quarterly)
- If still sufficient lubricant is on the rope. No need for relubrication. Maybe on certain parts of the rope only!
- Give time after lubrication to evaporate the solvent (e.g. during production break, low duty or out of service at night, weekend or maintenance break).

Principle: Less lubricant quantity by maintenance service but more regular continous inspections.
For cleaning one can work with dry ice blasting system (coldjet), compressed air and brush system. The rope surface should be clean and dry. The product penetrates and sticks better on the metallic surface. The containing solvent allows the product to penetrate as well as possible into the rope.

## Back-end Cuts

The number of cycles between successive back-ends on drum winders will be agreed to between the mine and WireCo. Determination of the permissible cycles between back-ends, is to be based on the operating history of the winder, rope NDT results and visual inspections of the turn and layer cross-over points, on the winder drum.
Integral to the "running-in" procedure, WireCo requires that, the first 2 (two) back-end cuts be performed at circa 7.500 (seven thousand five hundred) cycles). Subsequent back-end cuts will then be performed thereafter, based on the findings of the prior intervention(s), supported by NDT and visual examination(s), during the initial back-end cuts. the rope.
WireCo requires that, a minimum of 1/8th of the drum circumference be cut from the back-end during such an intervention(s), to ensure that, accumulated damage accrued at the cross over and layer cross overs, are effectively retarded from the scuffing and accelerated wear zones. Tension on the back-end mine winder dead turns, must be maintained at a minimum of 50% of the maximum operating load, at all times after installation. This implies, doubling down with a full conveyance after every back-end cut. Note; at each back-end intervention, the mine winder rope must be twisted consistently in the winder rope's manufactured direction of lay, in the hawse hole, by at least 45°.

## Front-end Cuts

The accumulated front-end cuts should not exceed the accumulated back-end cuts, at any given time. This is to prevent sections of the mine winder rope, exposed to accelerated wear and plastic deformation on the dead layers, from entering the "live" section of mine winder rope.

# SUCCESS STORY: TELFER MINE

**Special mining rope break records in Australia**

The last 6 years saw a close cooperation between the rope manufacturer CASAR and the Telfer gold mine, based in the Pilbara region in the state of Western Australia. The Telfer mine is wholly owned by Newcrest Mining Limited. Gold and copper are extracted, above ground as well as underground. The copper and gold deposits were discovered in 1972, and mining began in 1977. In 2008 it was decided to increase the extraction capacities to over 6 million tons per year. This provided the basis for initial talks between Telfer and CASAR about the service life of the original ropes used on the floor hoisting machine and now the extraction capacities were due to increase too. The hoisting machine is a ground mounted friction winder which transports a payload of 34.5t at a speed of 16.25m/s from a depth of 1132m to the top.

The service life of the original ropes was maximally 95,000 cycles, corresponding to almost a year. The costs incurred by downtimes and the rope replacement after 95,000 cycles were immense and had to be drastically reduced to make extraction cost-effective. After a profound study of the site and application, CASAR decided to deploy a Starplast construction. This is a rotation-free rope construction made of compacted strands. A rope set consists of 4 hoist ropes, each with a length of 1360m and a rope diameter of 45mm.

CASAR succeeded to continuously increase the lifetime up to 210,000 cycles reached with the 3. version of Starplast. The result was overwhelming as the lifetime was more than double the previous figure. Furthermore, the ropes were in perfect condition even after these 210,000 cycles and only had to be discarded as a result of mechanical damage due to rockfall, not because of wear and tear. In addition, it was possible to virtually exclude undesired effects such as rope elongation and rope slipping on the drum, and wear on the inlays of the rope discs was reduced to less than a quarter of the previous value. In particular the reduction of the elongation effect is really valued by Telfer as the usually necessary shortening of the ropes after occurrence of the setting effect is no longer necessary. At present the value of elongation for the 4. version of CASAR Starplast is less than 800mm.
CASAR and Telfer are confident that they are able to use the knowledge gained to further increase the service life

to over 300,000 cycles. In this case the ropes would not have to be replaced for at least 3 years. This alone would represent major cost savings for the mine and also save a lot of time which could be used for other maintenance and repair work. It is estimated that at least 10 working days that would normally be needed to replace the rope could already be saved during the service life of the rope currently being used. The ropes currently in use already reached 170,000 cycles in March 2015 and are still in perfect condition. We are therefore confident of reaching the set goal. What Telfer particularly values in CASAR is that the efforts started in 2008 aimed at increasing the service life were back up throughout with advice and support. Not only were system measurements and destruction-free rope examinations carried out on site, but there were also intensive examinations of discarded rope pieces at CASAR, always focused on improving the product. Overall, this package of customised products coupled with outstanding expertise and technical support on-site has resulted in Telfer purchasing their hoist ropes exclusively from CASAR in Germany since 2009.

## 3 TIMES LONGER SERVICE LIFE

Product specifications are subject to change without notice or obligation. The shown photographs, drawings or cross sections are only for illustrative purposes, the images can vary depending on requested diameter and current status of technical development.

The information supplied in this brochure is only a guideline for rope selection. Please contact us for any information or advice on the use of our ropes or if you have any doubt in selecting a rope for a specific application.

Any warranty, expressed or implied as to quality, performance or fitness for use of WireCo WorldGroup products is always premised on the condition that the published strengths apply only to new, unused products, that the mechanical equipment on which such products are used is properly designed and maintained, that such products are properly stored, handled, used and maintained, and properly inspected on a regular basis during the period of use.

Seller shall not be liable under any circumstances for consequential or incidental damages or secondary charges including but not limited to personal injury, labor costs, a loss of profits resulting from the use of said products or from said products being incorporated in or becoming a component of any other product.



Please note: Not all products are available in all countries according to local requirements. Please consult your local Casar distributor for more information.

**WIRECO Germany GmbH**
Casarstrasse 1
D-66459 Kirkel-Limbach
Postfach 1187 | D-66454 Kirkel
GERMANY

Phone: +49 6841 8091-0
E-Mail: info@casar.de
**Internet: www.casar.de**

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