



INDUSTRIAL FIBER ROPE

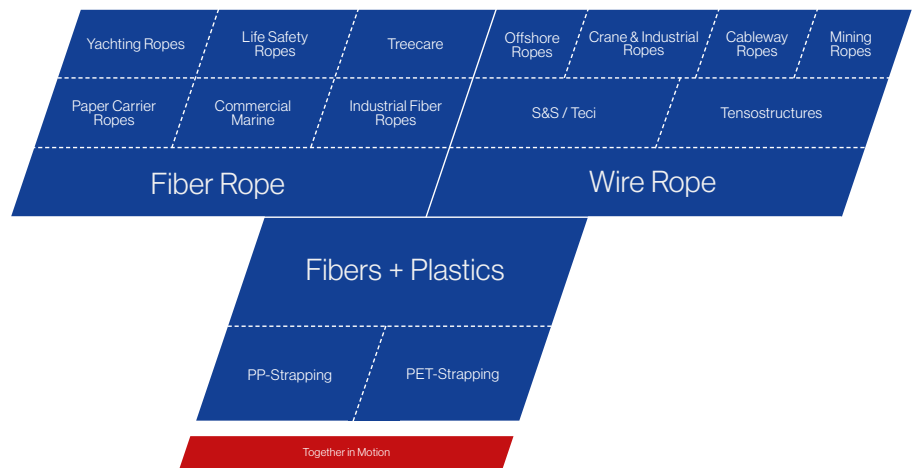
Fiber ropes for industrial applications

EXPERTISE FROM 230 YEARS OF EXPERIENCE

What started back in 1790 as a simple shop making hemp ropes has since evolved into a globally successful group of enterprises specializing in the development and production of fiber and steel wire ropes as well as strapping.

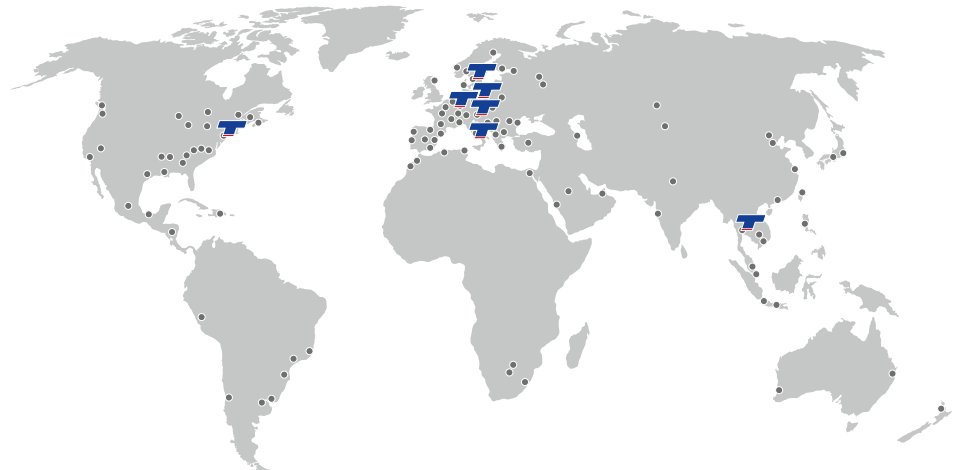
Vast diversity

TEUFELBERGER's products and services are destined for a wide variety of applications ranging from cranes and marine applications to packaging and through to personal protection. The continuity and stability of a family enterprise makes us a reliable partner who, competently and effectively, supports you in mastering your day-to-day challenges.



Global presence ensures customer proximity

Manufacturing operations in various countries allow us to meet local quality and certification standards as well as customer requirements without difficulty. From our sites in Austria, the Czech Republic, the U.S., Italy, Sweden, and Thailand, and backed by a close-knit global network of distribution partners, we continue to satisfy the expectations of our customers.



Innovative solutions through synergies

TEUFELBERGER is a leading specialist for fiber and steel wire ropes as well as strapping. The spectrum of technologies in TEUFELBERGER's portfolio generates various synergies between the extrusion of thermoplastics, the braiding of high performance fibers, and the processing of wires into ropes and strapping.

Especially fiber and steel wire products have brought about valuable synergies with regard to both application and manufacturing technologies, which have benefited our customers tremendously. This makes TEUFELBERGER your ideal partner right from the project planning phase.

5% of TEUFELBERGER's employees are active in research and development and make sure that our customers have access to the latest innovative rope technologies. 10% of the entire investment volume is committed to development and quality assurance.

FIBER ROPES FOR INDUSTRIAL APPLICATIONS

In our dedication to business success, we live by the “customer first” principle. The whole organization is oriented towards those people who rely on our products day-in, day-out.

In the field of industrial applications the requirements are highly versatile. Extensive market knowledge paired with the profound expertise of our research and development team allows us to generate customized solutions for almost any purpose that ropes can be used for. The customer provides the functional requirements – and we deliver a first class solution.

Innovation is a main driver – constant research has proven essential to transform bright ideas into great products and keep our production procedures upfront regarding quality and performance levels.

Whilst a lot of our effort is dedicated to customized solutions for various industries like automotive, utility, agriculture, winch makers, wind industry and many others, we prove our avant-garde spirit by permanently creating new product lines and technologies, e.g., our

STRATOS® forestry program, PLATINUM® technology, soLITE® or STS - Stronger Than Steel®. These and many other innovative details can be found in TEUFELBERGER Fiber Rope products.

Service is a further main key for long term relations with our business partners. The understanding at TEUFELBERGER is that service does not end after our goods left the warehouse. We are glad being able to offer you professional support for the correct, efficient and economic use of the products and advice during the whole product-lifetime up to the point where repair or replacement is required.

TEUFELBERGER – innovative, competent and reliable support for your industrial fiber rope application.

Attention

Using these products may be dangerous. Only use our products for the purposes they are intended for. Customers must ensure that the persons using these products are familiar with their correct use and the necessary safety precautions. Please bear in mind that any of these products may cause damage or harm when used improperly or subjected to excessive loads.

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FIBER STRUCTURES

Monofilaments

The yarns consist of one single element of a relatively large diameter and are braided into a rope.

Characteristics:

- ✓ Very good abrasion resistance
- ✓ Low dirt take-up
- ✓ Stiff structure

Textured fibers

A certain degree of disorder is caused in a formerly straight bundle of synthetic fibers to generate characteristics which are usually seen only on natural fibers.

Characteristics:

- ✓ Good grip
- ✓ High elasticity
- ✓ Traditional look and feel

Multifilaments

A bundle of thin fibers processed into twines which then are braided into a rope. The majority of fiber ropes follow this basic design.

Characteristics:

- ✓ High flexibility
- ✓ High tensile strength

Staple fibers

This type of material consists of spun pieces of short filaments instead of a bundle of long ones.

Characteristics:

- ✓ Excellent grip
- ✓ Soft handling



RAW MATERIALS

PBO (Polybenzoxazoles, Crystal Polymer)

The generic fiber PBO also known as Zylon® is a high performance fiber with the highest strength and lowest stretch of any commercially available fiber. It is extremely expensive and quickly loses its strength when exposed to UV-rays.

UHMWPE (Ultra High Molecular Weight Polyethylene)

UHMWPE (also known as UHMPE or HMPE Dyneema®) is an extremely high strength fiber of ultra high molecular polyethylene. For the same weight it has approx. 15 times the tensile strength of steel. Rope made from this type of fiber shows very low elongation and tensile strength. If very high loads are being applied for a long period of time, Standard UHMWPE fiber tends to creep. The rope then is irreversibly extending its length. But for critical applications, UHMWPE fibers with reduced creep behavior are available. Furthermore, these robust fibers show excellent performance in terms of abrasion resistance and good UV-resistance.

Aramid (Aromatic Polyamide)

Aramid fibers have an extremely high breaking load and show almost no stretch. On the other hand, they are sensitive to UV-rays, bending over sharp edges, and abrasion. It is mainly used in places where high temperature resistance is essential, for example on winches or in hot air balloon ropes, or for any other application where heat exposure needs to be considered.

LCP (Liquid Crystal Polymer)

LCP (also known as Vectran®), combines extremely low elongation with extremely high breaking loads. However, its UV-resistance is not very high. It is heat resistant and not very sensitive to bending over sharp edges. The big advantage of Vectran® is, however, that compared to UHMWPE it does not creep.

PES (Polyester)

Static ropes made of polyester fibers are characterized by good breaking loads and low stretch. This material offers both chemical and physical advantages such as UV resistance salt water resistance, and good abrasion strength in both dry and wet conditions. However, the dynamic

energy absorption capacity is much lower than that of nylon ropes and therefore only to a limited extent suitable for types of use involving high impact forces.

PA (Polyamide)

Polyamide has a high breaking load as well as high elongation. Preferably, it is used in products that are required to absorb shock loads. The abrasion resistance of polyamide is better in wet conditions than in dry conditions because it tends to take up water. Kept in wet conditions for too long, the material can become stiff. Another disadvantage compared to polyester is the lower resistance to UV-radiation in sunlight.

PP (Polypropylene)

Due to its limited technical characteristics, polypropylene is only used for simple applications. PP is very light and even buoyant in water. Its abrasion resistance and temperature resistance are lower than those of most other fibers.



Technical properties of available raw materials

	PBO	UHMWPE	Armid	LCP	PES	PA	PP
	Polybenzoxazoles, Crystal Polymer	Ultra High Molecular Weight Polyethylene	Aromatic Polyamide	Liquid Crystal Polymer	Polyester	Polyamide	Polypropylene
Typical Marketing Term	Zylon®	Dyneema®	Technora®/ Twaron®/ Kevlar®	Vectran®	PES	PA/Nylon	PP
Strength (daN/mm²)	574	340	340	320	110	81	52
Specific weight (g/cm³)	1.54 – 1.56	0.97	1.40	1.40	1.38	1.14	0.91
Water intake (%)	0.6 – 2.0	0	2	<0.1	<0.5	4 – 6	0
UV-resistance	low	good	limited	limited	very well	average	good
Elongation to break (%)	2.5 – 3.5	3.5	4.4	3.0	10 – 16	19 – 25	18 – 22
Abrasion resistance (dry)	good	very good	limited	very good	good	very good	sufficient
Abrasion resistance (wet)	good	very good	limited	very good	very good	good	good
Creep	almost not measurable	at high loads	almost not measurable	not measurable	almost not measurable	low	at high loads
Melting temp. (°C)	charred at 650	140	charred at 500	330	260	230	165

ROPE CORES

PBO (Zylon®)

To obtain the outstanding performance level of PBO, it is recommended to use a protective cover. Properties like highest breaking load, very low elongation and zero creep need to be preserved by a solid cover to hinder degrading caused by UV and other environmental influences.



UHMWPE – stretched Cores made with STS-Stronger Than Steel® technology

In an unique stretching process, carefully controlled heat and tension is used to match the length of the UHMWPE-fibers within the rope while applied load is distributed evenly between several load carrying elements. At the same time, construction-dependent elongation is reduced to a minimum. Main benefits are a longer service life, higher breaking loads, and less constructional elongation. Advanced impregnation technology (S.Y.I.S. - Single Yarn Impregnation System) is applying a protective shield to prevent negative influences from UV, dirt and chafing.



STS – Stronger Than Steel® technology

When looking for particularly high-performing ropes, one automatically thinks of steel wire ropes. But now we have STS – Stronger Than Steel®. Conceived and constructed by TEUFELBERGER's development team, this fiber rope is not only much lighter than a steel wire rope, but also much more effective. This is made possible

by a combination of high-tech fibers, an optimized rope design, and an innovative pre-stretching process. This process lends highest breaking forces to the rope that, combined with minimal weight and diameter, make it ideally suited for a variety of industrial applications.

UHMWPE – unstretched

A robust 12 strand construction of UHMWPE fibers forms the basis of this rope core. During braiding procedures, we proceed with the same diligence as for our STS - Stronger Than Steel® products. However, no heat stretching is applied to this type of product. Impregnations can be used to influence specific performance characteristics. The result is a high tensile, low elongation braid that is well prepared to withstand harsh conditions with or without rope cover.



Aramid (Kevlar®, Technora®, Twaron®)

The main argument in favor of using aramid based constructions is that they combine high breaking loads with very good heat resistance. Aramid has proven to be a reliable material for applications where temperature is the main cause of concern.



LCP (Vectran®)

Vectran® is providing a great combination of low elongation, high breaking load, and advanced heat resistance. Often, it is required to protect this high grade fiber with a braided cover to block UV-rays. Vectran® does not exhibit any creep, even if tension is high applied for a long period of time.



Polyester

The first choice for general purpose ropes. Good tensile strength and low elongation combined with very good UV-resistance make it the best choice for any low profile application. Polyester is available in many different colors.



Polyamide

Polyamide is perfectly suitable for applications where a certain degree of elasticity is a main requirement. Furthermore, good handling characteristics can be obtained with it. Under wet conditions, it changes its characteristics as it takes up water.



Polypropylene

Whenever best economy is the driving argument, PP is worth a consideration. Breaking loads and elongation characteristics are below the level of most other fibers, while it is the material with the best buoyancy among synthetic fibers.



ROPE COVERS



Polyester

High UV-resistance and good abrasion resistance make polyester a first choice for cover braids. It provides an economic way to protect premium rope cores made from UHMWPE, PBO, LCP or aramid to increase lifetime.



UHMWPE

For any application that requires highest abrasion resistance and breaking load at the same time, a UHMWPE cover is the first choice in combination with a high performance level core material (UHMWPE, PBO, LCP or aramid)



UHMWPE - Polyester

To get the best of two worlds it is also possible to combine UHMWPE and polyester. The result is an improved abrasion resistance of the cover at a very economic level.



Aramid

Covers made from aramid fibers are usually used to provide heat protection to a core having limited heat resistance.



Taslan – Polyester

Taslan is textured polyamide and adds grip to any cover construction. In combination with polyester, it gives a rugged and slip prove rope surface.



UHMWPE - PBO

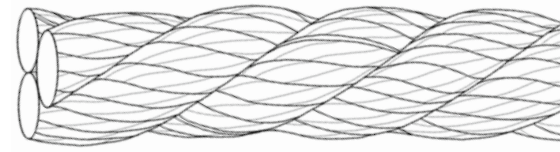
Combining UHMWPE and PBO in a rope cover provides a maximum of abrasion resistance to the rope. Due to the low-resistance of PBO, its performance will deteriorate rather quickly. It is recommended only for applications where ropes are worn quickly and will be replaced on a regular basis. Individual color and fiber compositions available on request. Technical color patterns applicable to most cover raw materials (e.g., to indicate twist or elongation, phosphorescence, etc.).

ROPE CONSTRUCTIONS

We at TEUFELBERGER go the extra mile to get the maximum performance out of each of our ropes. Whatever you expect from your rope, we have the right product for you.

3-Strand

A special stabilization process and a solid, balanced construction produce a durable, long-lasting, flexible and easy-to-handle rope that won't harden with age.



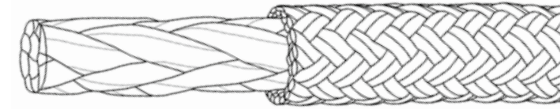
Single braid

A supple construction that absorbs twist and does not kink. This simple construction provides great ease of splicing.



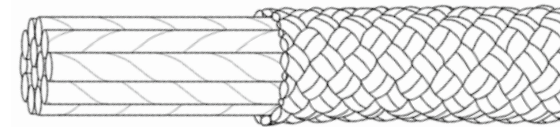
Double braid

A braided core inside a braided cover produces an easy-to-handle rope that is strong and very durable. Since the rope consists of two individual parts, it is possible to combine different fibers to create ropes merging specific characteristics of different raw materials. For example, a high tensile core with a heat resistant cover.



Parallel core kernmantle construction

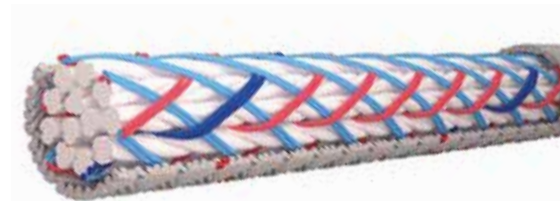
A patented unidirectional fiber core with a braided cover produces a line with significantly less stretch and greater strength than the same size double braid line.



PLATINUM®

PLATINUM® is the name of TEUFELBERGER's innovative braiding technology. For the first time in the history of rope making, previously independent elements of a rope are interconnected into one unit.

What makes PLATINUM® so special compared to the kernmantle ropes currently available on the market? In conventional double-braided ropes, there is no connection between the core and the cover. The two components are loose and movable. With the innovative and patented PLATINUM® technology, TEUFELBERGER successfully obtained a mechanical and durable connection between the core and the cover. Moreover, PLATINUM® connects parallel cores to one another, thus relieving the load the previously heavily loaded outer yarns are exposed to.



COATINGS AND SPECIAL TREATMENTS

Technique

S.Y.I.S. – Single Yarn Impregnation System

Before braiding the rope, all single yarns are being dipped and fixed. Added color pigments allow to apply any desired color.

Rope coating

After braiding the rope, the complete construction is dipped in a calibrated procedure. Again, a final fixing step will be carried out to ensure that applied substances remain attached to the rope's fibers as long as possible.

Coating materials

We use a huge variety of compositions to influence specific rope properties in a carefully controlled manner. For this purpose, we rely on the following substances:

- ✓ Polyurethane
- ✓ Silicone
- ✓ Wax
- ✓ Acrylate
- ✓ PTFE

Improved rope properties

The following specific rope properties can be improved by coating:

- ✓ Abrasion resistance
- ✓ UV-resistance
- ✓ Water repellence
- ✓ Mold resistance
- ✓ Keeping colour
- ✓ Friction coefficient
- ✓ Sliding properties
- ✓ Fire retardance
- ✓ Bending resistance



Large variety.

The wide range of possible combinations has a controlled effect on specific rope properties.

TERMINATIONS

Splice

A splice is obtainable for all single and double braids and creates a firm yet flexible termination. In case of double braids, all of the highly stressed loop and splice area is protected by overbraiding. When the splice is made properly, the breaking force reduction as compared with the free rope length is 0 - 10% (depending on the type of rope).

Splice with thimble

A splice with thimble is the ideal connection to metal parts such as bolts, connectors, or hooks ensuring optimum protection of the rope. Here, too, the highly stressed area of a double braid around the thimble is protected by overbraiding and whipping.

End bond

Fitting the end of a fiber rope with a socketing cone is a high-tech solution offering both a maximum of tensile strength and unlimited flexibility in designing the metal end bond. The socketing cone itself features a thread to which any rope end termination can be connected. Depending on the care and accuracy applied by the person making the end bond as well as his or her experience, breaking force reductions between 0 and 25%, compared with the free rope length, are possible.

Stitched terminations

TEUFELBERGER cuts the rope to the required length and tailors stitched terminations to individual requirements. By building on decades of sewing experience and a great wealth of expertise in this field, we succeed in maintaining breaking forces at a very high level.

Swaging

Swaging is a very economical way to form an eye at the end of a rope. A quick pressing process provides a durable termination for simple applications. It is often used for mass-produced products with a low technical profile. However, the breaking force reduction as compared with the free rope length is substantial.

Tapered end

Rope and cord which is provided as a component for various pieces of machinery or appliances is often required to be prepared for a final assembly process. Tapered ends are important to facilitate easy and quick mounting procedures.



TEUFELBERGER Fiber Rope GmbH

Vogelweiderstraße 50

4600 Wels, Austria

Telephone: +43 (0) 7242 413-0

Fax: +43 (0) 7242 413-169

fiberrope@teufelberger.com

www.teufelberger.com

