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Wire Rope User's Handbook

A WireCo® WorldGroup Brand

Union®

CONTENTS

WIRE ROPE BASICS

Page(s)

Importance of rope strands, construction and classification **2-5**

Relationship of wire, lay and preforming to wire rope performance and operation **6-7**

Choosing the right wire rope for your application **8-9**

How to measure wire rope diameter **10-11**
> Metric conversions
> Design factors and how to use them

WIRE ROPE PRODUCTS

6 x 19 and 6 x 36 classifications **12-13**

Rotation-resistant and low-torque ropes **14-17**
> Starlift Xtra, Flex-X 19, XLT4

Premium value ropes **18-21**
> Flex-X 6, Flex-X 9, PFV, 7-Flex and Flex-X 7CC

Mining wire ropes **22**
> TUF-MAX shovel ropes, PowerMax drag ropes, PowerMax MD drag ropes

Flattened strand ropes and 6 x 7 sandlines **23**

Swaged ropes and PowerFlex **24**

Specialty small ropes **25**

Galvanized strand products **26**

PROPER WIRE ROPE USE

Wire rope end treatments **27**

How to extend wire rope service life **28-29**

Wire rope inspection **30-31**

Wire rope wear, abuse and removal criteria **32-33**

How to unreel, uncoil and store wire rope **34**

Standard wire rope abbreviations and warning **35**

Glossary of wire rope terms **36-37**

Union®

Wire rope like no other

When it comes to showing you the ropes, no one does it like Union. Our products are backed by years of experience in the field, at your side – solving tough problems in unique applications.

We've matched the science of design with the art of skillful manufacturing craftsmanship to build the best wire rope in the world.

No matter where you are in the world, Union delivers hard-working products, exceptional service and unmatched support. At Union, we're with you in the field, on the rig and in the mine, getting our hands dirty to supply tough ropes that help you get the job done – better.

SMALL TOWN ROOTS, GLOBAL LEADERSHIP

From simple beginnings, Union has grown to be the world's premier wire rope brand. Part of WireCo WorldGroup, Union is now part of the global leader in manufacturing, engineering and distributing wire rope, wire rope assemblies, high carbon wire, and electromechanical cable.

WireCo WorldGroup has grown – and endured – to be the largest producer of wire rope and EM cable in the world, offering the broadest product line and best service. With the global reach of WireCo WorldGroup behind it, Union can deliver the right wire ropes for your machine and application no matter where your worksite may be.

WIRECO WORLDGROUP: THE WORLD IS OUR WORKSITE

Engineering wire rope for your application is a highly specialized field – with exacting standards – that we gladly live by. Across the entire WireCo WorldGroup organization, we draw from our global pool of talented engineers to drive results for your application.

Nine WireCo WorldGroup manufacturing operations and eight distribution centers in North America, plus manufacturing facilities in Germany, Portugal and China, give our customers unparalleled support and global reach.

Our manufacturing standards typically exceed the minimum design standards for a wire rope. We take an active role in industry associations that develop wire rope specifications and standards, such as ASTM A1023.

WireCo WorldGroup world headquarters, located in Kansas City, Missouri.

We apply thorough design and manufacturing controls – including complete material traceability. And we are the only manufacturer in the world that is QPL qualified, API Spec 9A certified, and registered to both ISO 9001 and AS-9100 Quality Systems.

So, look to the best: The Union brand backed by the WireCo WorldGroup organization. We're dedicated to matching and advancing wire, wire rope and electromechanical cables to your dynamic applications throughout the world.

With a global manufacturing and distribution base, along with our unmatched technical expertise, the world is our worksite.

LEARN THE ROPES WITH OUR HANDBOOK

WIRE ROPE BASICS Learn the basics of wire rope, including the nomenclature, how it is constructed, and how diameter and lay measurements are made.

WIRE ROPE PRODUCTS View the industry's most complete line of wire rope products including Flex-X ropes, Flex-X 7 CC, PowerMax, PFV, 7-Flex, rotation-resistant and swaged ropes, and other special types.

PROPER ROPE USE Learn how to choose the right ropes for your needs, how to extend rope service life, the importance of inspection, and how to properly store and handle wire rope.

Wire rope classifications and features

NUMBER OF STRANDS AND CONSTRUCTION DETERMINE WIRE ROPE CLASSIFICATION

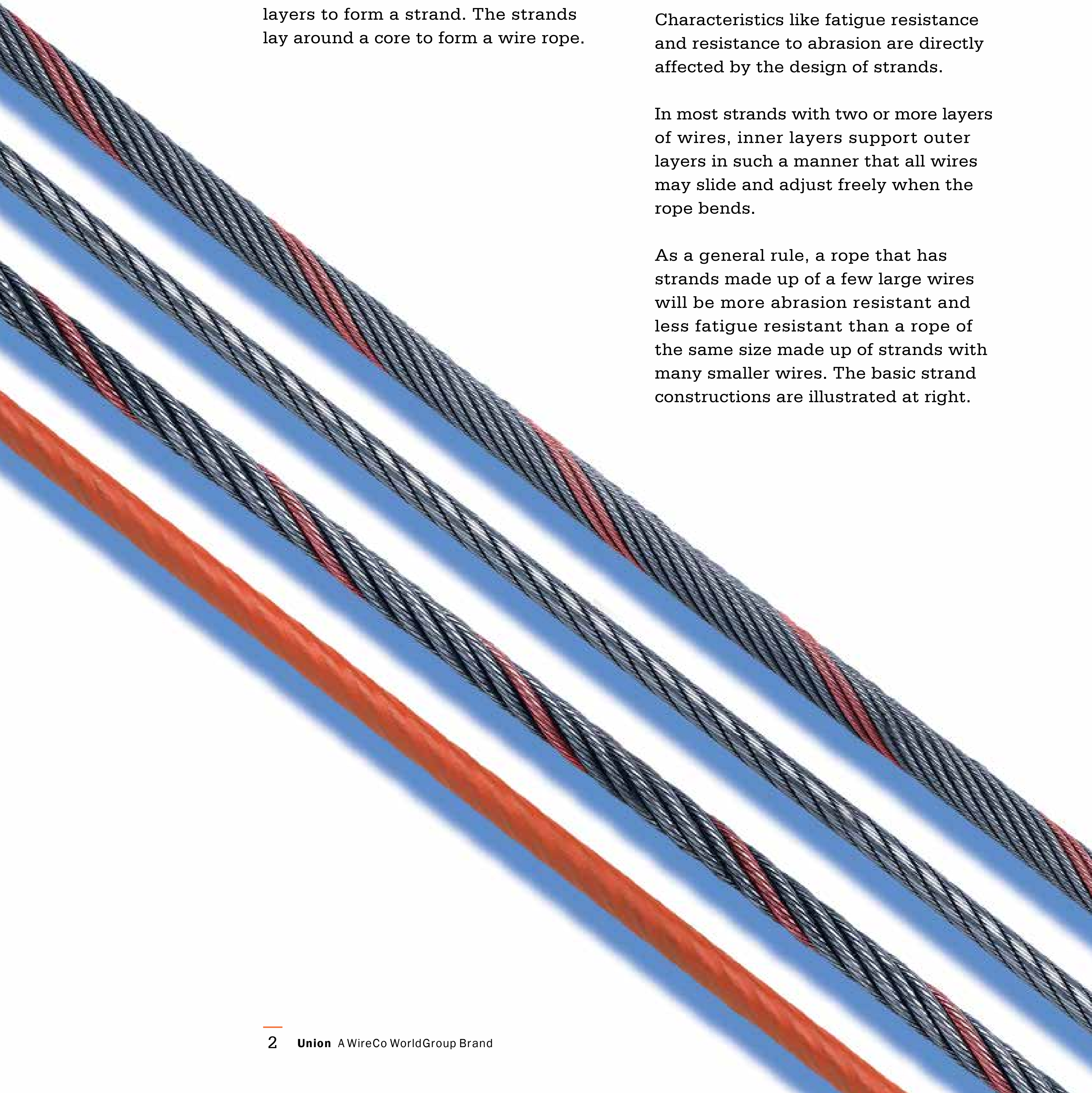
Wires are the basic building blocks of a wire rope. They lay around a "center" in a specified pattern in one or more layers to form a strand. The strands lay around a core to form a wire rope.

The strands provide all the tensile strength of a fiber core rope and over 90% of the strength of a typical 6-strand wire rope with an independent wire rope core.

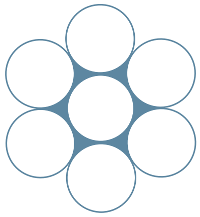
Characteristics like fatigue resistance and resistance to abrasion are directly affected by the design of strands.

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.

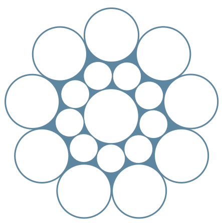
As a general rule, a rope that has strands made up of a few large wires will be more abrasion resistant and less fatigue resistant than a rope of the same size made up of strands with many smaller wires. The basic strand constructions are illustrated at right.



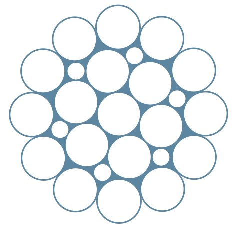
SINGLE LAYER The most common example of the single layer construction is a 7 wire strand. It has a single-wire center with six wires of the same diameter around it.



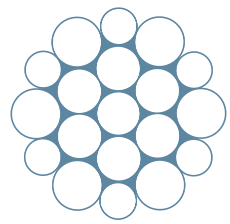
SEALE This construction has two layers of wires around a center with the same number of wires in each layer. All wires in each layer are the same diameter. The strand is designed so that the large outer wires rest in the valleys between the smaller inner wires. Example: 19 Seale (1-9-9) strand.



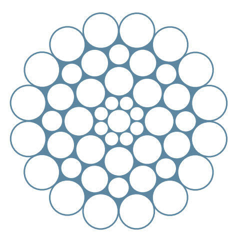
FILLER WIRE This construction has two layers of uniform-size wire around a center with the inner layer having half the number of wires as the outer layer. Small filler wires, equal in number to the inner layer, are laid in valleys of the inner layer. Example: 25 Filler Wire (1-6-6f-12) strand.



WARRINGTON 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 outer-layer wires rest in the valleys, and the smaller ones on the crowns, of the inner layer. Example: 19 Warrington [1-6-(6+6)].



COMBINED PATTERNS When a strand is formed in a single operation using two or more of the above constructions, it is referred to as a "combined pattern." This example is a Seale construction in its first two layers. The third layer utilizes the Warrington construction, and the outer layer is a Seale construction. It's described as: 49 Seale Warrington Seale [1-8-8-(8+8)-16].



Wire rope classifications and features (continued)

UNUSUAL OPERATING CONDITIONS OFTEN REQUIRE ROPES OF SPECIAL DESIGN

> Stresses or environments of some applications can seriously impair the performance of standard ropes.

STANDARD ROPE CLASSIFICATIONS

All rope of the same size, grade and core in each classification have the same minimum breaking force and weight per foot. Different constructions within each classification differ in working characteristics. Consider these features whenever you're selecting a rope for a specific application.

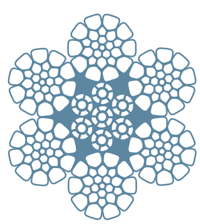
Classification*	Wires per strand
6 x 7	7 through 15
6 x 19	16 through 26
6 x 36	27 through 49
6 x 61	50 through 74

*Classifications are the same in 7 and 8 strand wire ropes

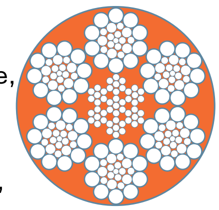
SPECIAL ROPE CONSTRUCTIONS

Unusual operating conditions often require ropes of special ropes to better withstand stresses or environments that would seriously impair performance of standard ropes. Ropes that may meet these needs include the following:

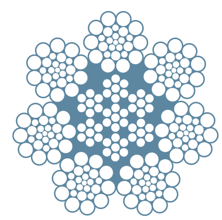
> **FLEX-X®** A special process that creates more strand surface area on the rope to help spread contact, decrease wear, reduce drum and sheave wear and extend service life. With greater surface area and more steel per diameter than conventional ropes, Flex-X provides higher strength and better wear resistance. Its high-density strands are compacted for extra strength and resistance to abrasion, crushing and bending fatigue.



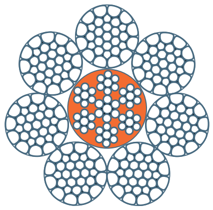
> **TUF-KOTE®/PFV®** A plastic impregnated wire rope proven to provide longer service life and a cleaner operation. On the inside, top-of-the-line wire rope resists the demanding pressures of your job. The polymer is applied at high pressure to force the material into the rope, serving to cushion the strands, distribute internal stresses, keep in wire rope lubricant and keep out dirt and debris. On the outside, the engineered polymer plastic is designed to provide a cleaner operation and reduces wear on sheaves and drums.



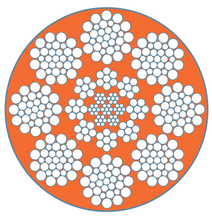
> **7-FLEX®** A rope construction that offers improved resistance to bending fatigue compared to a 6-strand rope of the same diameter due to a combination of the outer wire size and the seventh strand. The use of a 26 Warrington Seale (WS) strand construction provides a good balance of operating characteristics.



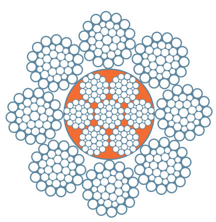
> **FLEX-X® 7 CC** Already a preferred rope for container cranes, Flex-X 7 CC is now providing extended service life in carriage operations and other applications where multi-sheave equipment and rigorous duty cycles induce fatigue stresses.



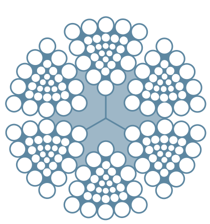
> **TUF-MAX®** These shovel ropes are manufactured with an enhanced coating process that makes them more resistant to external rope wear and helps extend drum and sheave life.



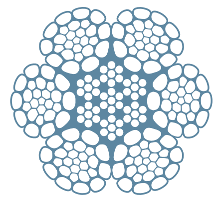
> **POWERMAX™** An 8-strand wire rope created to provide operating characteristics essential to drag and hoist ropes. PowerMax is more fatigue resistant than 6-strand ropes of the same diameter, plus, its greater surface area puts more steel in touch with contact surfaces reducing wear and abrasion.



> **FLATTENED (TRIANGULAR) STRAND** These ropes feature "shaped" strands formed so they will close together to achieve greater metallic area in the rope's cross-section and greater bearing surface for contact with sheaves and drums.



> **SWAGED ROPES** These ropes offer higher strength than standard ropes of the same diameter while providing greater resistance to drum crushing, scrubbing and similar surface wear. During manufacture, the rope is swaged to produce a compact cross-section with minimum voids and greater surface area.



ROPE CORES FORM A FOUNDATION FOR THE STRANDS

The primary function of the rope's core is to serve as the foundation for the strands – to keep the rope round and the strands properly positioned during operation. Your choice of core will have an effect upon the rope's performance.

THREE TYPES OF CORES ARE COMMONLY USED:

1. **FIBER CORE** Polypropylene is standard, but either natural sisal (or hemp) fiber or other man-made fibers are available on special request.

2. **INDEPENDENT WIRE ROPE CORE** Literally an independent wire rope with strands and a core, called IWRC. Most wire ropes made with steel core use an IWRC.

3. **STRAND CORE** A strand made of wires. Typically, strand cores are used in utility cables only.

THREE TYPES OF ROPE CORES:

> Fiber Core

> Independent Wire Rope Core

> Strand Core

Types of wire, lay and preforming affect wire rope performance and operation

PREFORMING PRESHAPES STRANDS BEFORE THE ROPE IS CLOSED.

> Preforming helically shapes the wires and strands into the shape they will assume in the finished rope. It improves handling and resistance to kinking by conforming the strands to the position they take in the rope.

> The superior qualities of preformed ropes result from wires and strands being "at rest" in the rope, which minimizes internal stresses within the rope. Today, preforming is virtually standard in most standard ropes, but specialty ropes may be non-preformed.

THE BASIC TYPES OF WIRE USED IN ROPES

BRIGHT WIRE Most ropes are made with uncoated (bright) wire that is manufactured from high-carbon steel. The chemistry of the steel used and the practice employed in drawing the wire are varied to supply the ultimate combination of tensile strength, fatigue resistance and wear resistance in the finished rope.

GALVANIZED WIRE This is often used to improve corrosion resistance of wire ropes. We use the following two different procedures to manufacture galvanized wire:

Galvanized to finished size wire is first drawn as a bright wire to a predetermined size that's smaller than the required finished wire size. This wire is then run through the galvanizing line, and the resultant coating of zinc increases the wire diameter to the finished size. Galvanized to finished size wire has a strength 10% lower than the same size and type of bright wire. Ropes made from this wire therefore have a minimum breaking force that's 10% lower than the equivalent size and grade of bright rope.

Drawn galvanized wire is galvanized before the final drawing to finish size. Since the galvanized coating also goes through the drawing process, it is much thinner than the coating on galvanized to finished size wire. Drawn galvanized wires are equal in strength to the same size and type of bright wire and drawn galvanized rope is equal in strength to the same size and grade of bright rope.

STAINLESS STEEL WIRE This is a special alloy containing approximately 18% chromium and 8% nickel. It has high resistance to many corrosive conditions and is used extensively in yachting ropes and control cables.

WIRE ROPE GRADES

The most common grade of rope today is called **Extra Improved Plow Steel Grade (XIP®)**. For most ropes, this will be the grade supplied. XIP ropes have a 15% higher minimum breaking force than most Improved Plow Steel Grade (IPS), the former standard strength.

Other grades of wire rope are also available, including **Extra Extra Improved Plow Steel Grade (XXIP®)**. Many equipment designers are specifying XXIP grade wire rope for the operating ropes on modern higher-rated equipment. They're taking advantage of its higher minimum breaking force to help reduce total system weight. New machines can be designed with higher ratings using smaller diameter rope due to XXIP's higher strength. Minimum breaking force of XXIP grade wire rope is 10% higher than XIP grade.

“Lay” has three meanings in rope design

> Right lay – Regular lay

> Left lay – Regular lay

> Right lay – Lang lay

> Left lay – Lang lay

The first two meanings of “lay” are descriptive of the wire and strand positions in the rope. The third meaning is a length measurement used in manufacturing and inspection.

1. The direction strands lay in the rope – right or left. 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.)

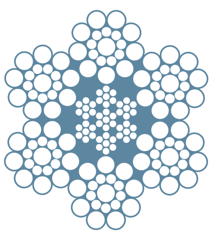
2. The relationship between the direction strands lay in the rope and the direction wires lay in the strands. In appearance, wires in regular lay appear to run straight down the length of the rope, and in lang lay, they appear to angle across the rope. In regular lay, wires are laid in the strand opposite the direction the strands lay in the rope. In lang lay, the wires are laid the same direction in the strand as the strands lay in the rope.

3. The length along the rope that a strand makes one complete spiral around the rope core. This is a measurement frequently used in wire rope inspection. Standards and regulations require removal when a certain number of broken wires per rope lay are found.

THE LAY OF A ROPE AFFECTS ITS OPERATIONAL CHARACTERISTICS

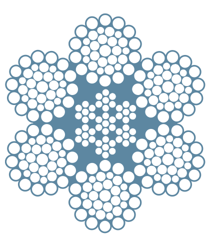
Regular lay is more stable and more resistant to crushing than lang lay. While lang lay is more fatigue resistant and abrasion resistant, use is normally limited to single layer spooling and when the rope and load are restrained from rotation.

Choosing the right wire rope for your application



IF YOU NEED ABRASION RESISTANCE

> Abrasion resistance increases with fewer, larger outside wires per strand.



IF YOU NEED FATIGUE RESISTANCE

> Fatigue resistance increases with more, smaller outside wires per strand.

With each application, your choices of wire ropes can be many. How do you know which one works best for you? Ropes include a combination of characteristics that give them specific performance abilities. Before you choose, it pays to look closely at each rope's special characteristics.

NO SINGLE WIRE ROPE CAN DO IT ALL

All wire ropes feature design characteristic tradeoffs. In most cases, a wire rope cannot increase both fatigue resistance and abrasion resistance. For example, when you increase fatigue resistance by selecting a rope with more wires, the rope will have less abrasion resistance because of its greater number of smaller outer wires.

When you need wire rope with greater abrasion resistance, one choice is a rope with fewer (and larger) outer wires to reduce the effects of surface wear. But that means the rope's fatigue resistance will decrease. That's why you need to choose your wire rope like you would any other machine. Very carefully. You must consider all operating conditions and rope characteristics.

THE BASIC CHARACTERISTICS OF WIRE ROPE

How do you choose the wire rope that's best suited for your job? Following are the most common characteristics to be considered when selecting a rope for an application.

STRENGTH Wire rope strength is usually measured in tons of 2,000 lbs. In published material, wire rope strength is shown as minimum breaking force (MBF) or nominal (catalog) strength. These refer to calculated strength figures that have been accepted by the wire rope industry.

When placed under tension on a test device, a new rope should break at a figure equal to – or higher than – the minimum breaking force shown for that rope.

The values in this handbook apply to new, unused rope. A rope should never operate at – or near – the minimum breaking force. During its useful life, a rope loses strength gradually due to natural causes such as surface wear and metal fatigue.

FATIGUE RESISTANCE Fatigue resistance involves metal fatigue of the wires that make up a rope. To have high fatigue resistance, wires must be capable of bending repeatedly under stress – for example, a rope passing over a sheave.

Increased fatigue resistance is achieved in a rope design by using a large number of wires. It involves both the basic metallurgy and the diameters of wires.

In general, a rope made of many wires will have greater fatigue resistance than a same-size rope made of fewer, larger wires because smaller wires have greater ability to bend as the rope passes over sheaves or around drums. To reduce the effects of fatigue, ropes must never bend over sheaves or drums with a diameter so small as to bend wires excessively. There are precise recommendations for sheave and drum sizes to properly accommodate all sizes and types of ropes.

Every rope is subject to metal fatigue from bending stress while in operation, and therefore the rope's strength gradually diminishes as the rope is used.

CRUSHING RESISTANCE Crushing is the effect of external pressure on a rope, which damages it by distorting the cross-section shape of the rope, its strands or core – or all three.

Crushing resistance therefore is a rope's ability to withstand or resist external forces, and is a term generally used to express comparison between ropes.

When a rope is damaged by crushing, the wires, strands and core are prevented from moving and adjusting normally during operation.

In general, IWRC ropes are more crush resistant than fiber core ropes. Regular lay ropes are more crush resistant than lang lay ropes. Six strand ropes have greater crush resistance than 8 strand ropes or 19 strand ropes. Flex-X® ropes are more crush resistant than standard round-strand ropes.

RESISTANCE TO METAL LOSS AND DEFORMATION Metal loss refers to the actual wearing away of metal from the outer wires of a rope, and metal deformation is the changing of the shape of outer wires of a rope.

In general, resistance to metal loss by abrasion (usually called "abrasion resistance") refers to a rope's ability to withstand metal being worn away along its exterior. This reduces strength of a rope.

The most common form of metal deformation is generally called "peening" – since outside wires of a peened rope appear to have been "hammered" along their exposed surface.

Peening usually occurs on drums, caused by rope-to-rope contact during spooling of the rope on the drum. It may also occur on sheaves.

Peening causes metal fatigue, which in turn may cause wire failure. The hammering – which causes the metal of the wire to flow into a new shape – realigns the grain structure of the metal, thereby affecting its fatigue resistance. The out-of-round shape also impairs wire movement when the rope bends.

RESISTANCE TO ROTATION When a load is placed on a rope, torque is created within the rope as wires and strands try to straighten out. This is normal and the rope is designed to operate with this load-induced torque. However, this torque can cause loads to rotate. Load-induced torque can be reduced by specially designed rotation resistant ropes.

In standard 6 and 8 strand ropes, the torques produced by the outer strands and the IWRC is in the same direction and add together. In rotation resistant ropes, the lay of the outer strands is in the opposite direction to the lay of the inner strands, thus the torques produced are in opposite directions and the torques subtract from each other.

Depending upon your application, other wire rope characteristics such as stability, bendability or reserve strength may need to be considered.

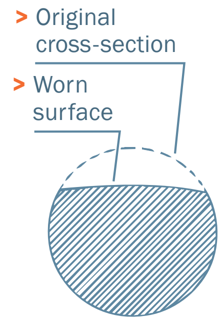
"SQUARED ENDS"

> Typical example of breaks due to fatigue.

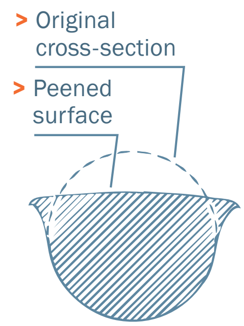
"CRUSHING"

> Typical example of external pressure on a wire rope.

CROSS-SECTION OF A WORN WIRE

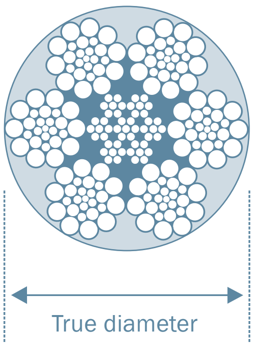


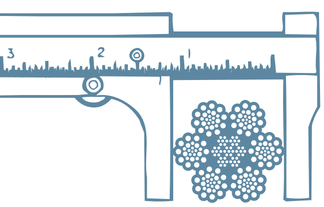
CROSS-SECTION OF A PEENED WIRE



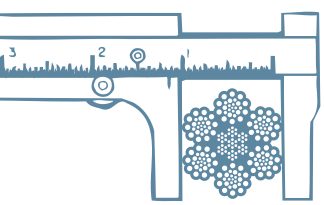
How to measure wire rope diameter

The correct diameter of a wire rope is the diameter of a circumscribed circle that will enclose all the strands. It's the largest cross-sectional measurement as shown here. You should make the measurement carefully with calipers. The illustrations





Correct



Incorrect

Metric conversion and equivalents

As we move toward metric measurements, it will become increasingly necessary to convert English units into SI – International System of Units – (or metrics), and vice versa. The following table and conversion factors are included in this handbook to help you.

ROPE DIAMETER
In measuring rope diameter, the industry is leaning toward a "soft" conversion to metric during the transition period. For example, a 1" diameter rope converts to 25.4 mm in metrics. Using the soft conversion, this is changed to the whole metric size that most nearly parallels the 1" size range, or 26 mm. In sizes smaller than 5/8", the rope diameter is rounded to the nearest 0.5 mm.

STRENGTHS AND WEIGHTS
The following table gives the closest equivalent metric diameters for rope sizes up through 5 inches. Again, these metric sizes are based on the industry's "soft" conversion.

Since rope minimum breaking force and weight per unit of length vary for different types and grade of ropes, the following conversion factors are given to help you convert the figures you need:

> To convert rope weight in pounds per foot (lb/ft) to kilograms per meter (kg/m), multiply by 1.488.

> To convert rope minimum breaking force in tons (T) to kilonewtons (kN), multiply by 8.897; 1 lb equals 4.448 newtons (N).

Nominal wire rope diameter

Inches	Millimeters	Inches	Millimeters
1/4	6.5	2 1/8	54
5/16	8	2 1/4	58
3/8	9.5	2 3/8	60
7/16	11.5	2 1/2	64
1/2	13	2 5/8	67
9/16	14.5	2 3/4	71
5/8	16	2 7/8	74
3/4	19	3	77
7/8	22	3 1/8	80
1	26	3 1/4	83
1 1/8	29	3 3/8	87
1 1/4	32	3 1/2	90
1 3/8	35	3 3/4	96
1 1/2	38	4	103
1 5/8	42	4 1/4	109
1 3/4	45	4 1/2	115
1 7/8	48	4 3/4	122
2	52	5	128

> To convert rope minimum breaking force in tons (T) to kilograms (kg), multiply by 907.2.

Note: The newton (a unit of force) is the correct unit for measurement of minimum breaking force in the SI system of units. We have included a conversion factor from tons to kilograms because a rope's minimum breaking force is often referred to in terms of kilograms (a unit of mass).

at left show the correct and incorrect methods of measuring a wire rope's diameter.

ALLOWABLE TOLERANCE IN WIRE ROPE DIAMETER

Wire rope is normally made slightly larger than its catalog (or nominal) size. The following chart lists the size tolerances of standard wire rope.

Nominal rope diameter	Tolerance Under	Over
0 - 1/8"	- 0	+ 8%
Over 1/8 - 3/16"	- 0	+ 7%
Over 3/16 - 5/16"	- 0	+ 6%
Over 5/16"	- 0	+ 5%

Design factors

The design factor is defined as the ratio of the minimum breaking force of a wire rope to the total load it is expected to carry.

Use of design factors provides rope installations with reasonable assurance of adequate capacity for the work to be done throughout a rope's service life. Considerations in establishing design factors include the type of service, design of equipment and consequences of failure.

In most applications, the selection of a rope based on the proper design factor has been made by the equipment manufacturer. In an application where a different rope is to be used, or in a new application, check government and industry regulations for the required design factor. Different rope types on the same application may have different design factor requirements.

HOW TO USE DESIGN FACTORS

Standards and regulations require that design factors be applied to the rope's minimum breaking force to determine the maximum working load. To determine the maximum working load for which an operating rope may be used, divide the rope's minimum breaking force by the required design factor. This is the rope's maximum working load. There may be other limiting factors in an application that make the maximum load the equipment can handle less than the rope's maximum working load.*

Remember, an installation is only at the prescribed design factor when the rope is new. As a rope is used, it loses strength and literally is "used up."

***NOTE**

> The rated capacity of a wire rope sling incorporates both a design factor and a splicing or attachment efficiency.

Standard 6 x 19 and 6 x 36 classification ropes

6 x 19 vs. 6 x 36

> It's a question of what your needs are. The 6 x 19 ropes emphasize abrasion resistance while the 6 x 36 ropes are important for their fatigue resistance.

The 6 x 19 classification of wire ropes includes standard 6 strand, round strand ropes with 16 through 26 wires per strand. The 6 x 36 classification of wire ropes includes standard 6 strand, round strand ropes with 27 through 49 wires per strand. Although their operating characteristics vary, all have the same weight per foot and the same minimum breaking force, size for size.

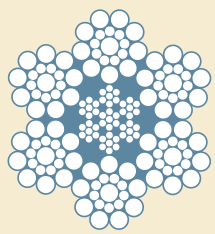
While the 6 x 19 ropes give primary emphasis to abrasion resistance in varying degrees, the 6 x 36 ropes are important for their fatigue resistance. This fatigue resistance is made possible by the greater number of small wires per strand.

Although there are exceptions for special applications, the constructions in 6 x 36 classification are primarily designed to be the most efficient for each rope diameter. As the rope size increases, for instance, a large number of wires can be used to achieve required fatigue resistance, and still those wires will be large enough to offer adequate resistance to abrasion.

CHARACTERISTICS OF STANDARD 6 X 19 AND 6 X 36 WIRE ROPES

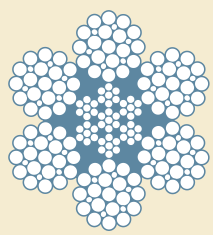
6 x 19 CLASS ROPES

6 x 19S (SEALE) This is a good rope to withstand abrasion or crushing on the drum but its fatigue resistance is decreased.



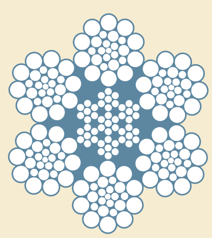
6 x 19S

6 x 25FW (FILLER WIRE) To most wire rope users, 6 x 19 means 6 x 25 filler wire. It is a common rope in the 6 x 19 classification.



6 x 25FW

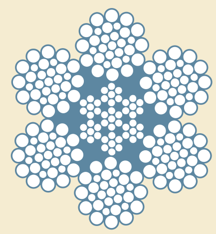
6 X 26WS (WARRINGTON SEALE) A standard 6 x 26WS design provides the best rope for a wide range of applications. In general, we recommend the use of a 6 x 26WS in any application where a 6 x 25FW is used.



6 x 26WS

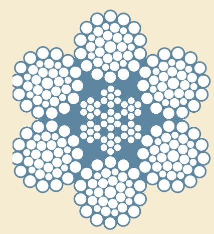
6 x 36 CLASS ROPES

In most rope sizes, only one 6 x 36 classification rope is made. These constructions were selected to provide fatigue resistance without having wires that are too small.

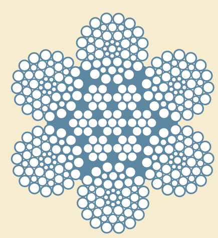


6 x 31WS

The greater number of wires in the 6 x 36 classification makes these ropes more susceptible to crushing. This can be minimized, however, by specifying an Independent Wire Rope Core (IWRC) and by using well-designed sheaves, grooved drums and proper operating techniques.



6 x 36WS

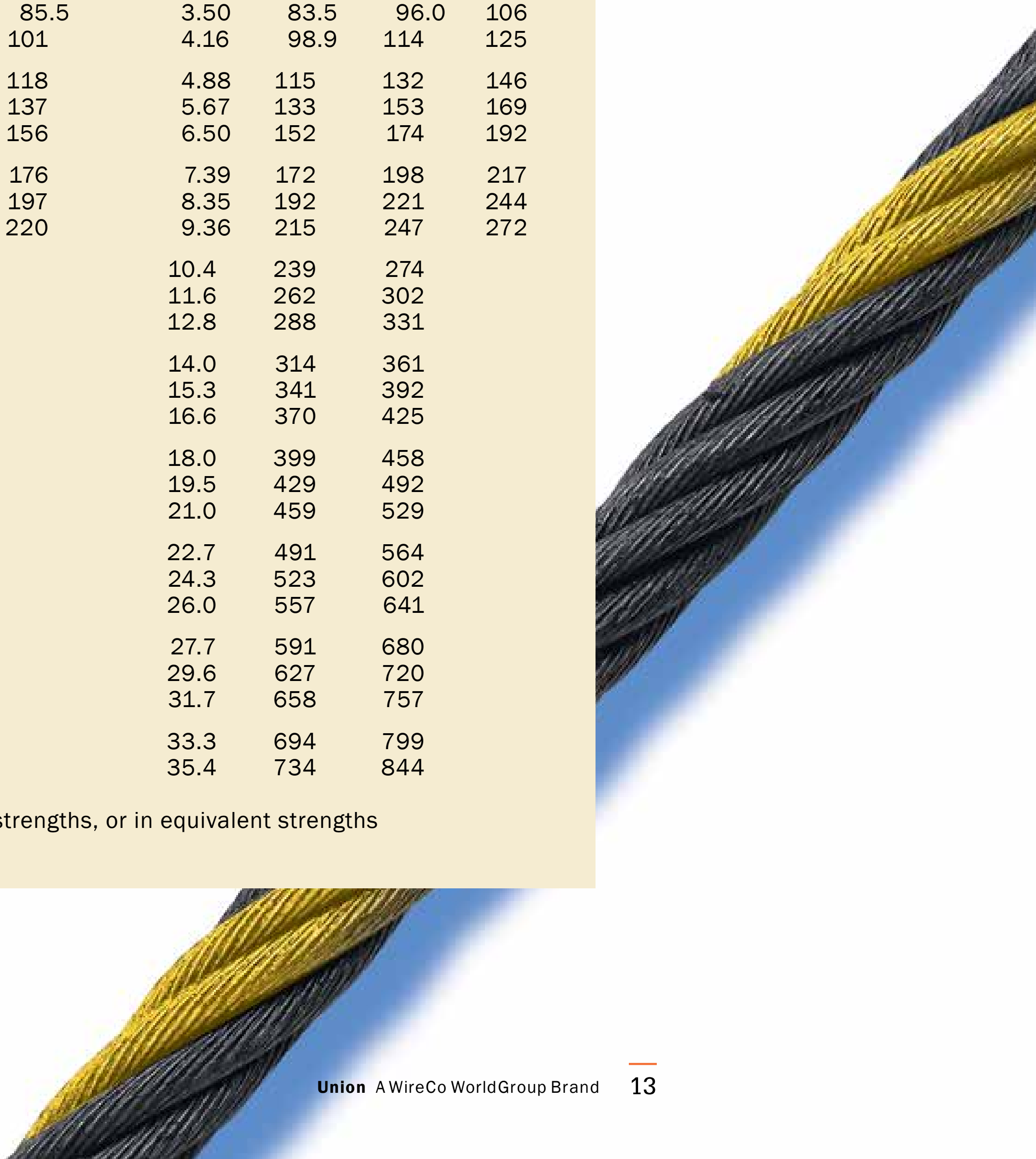


6 x 49SWS

MINIMUM BREAKING FORCE AND WEIGHTS FOR STANDARD 6 X 19 AND 6 X 36 CLASSIFICATION ROPES

	FIBER CORE			IWRC			
Diameter (in.)	Approx. wt./ft. (lbs.)	Minimum breaking force (tons of 2,000 lbs.)		Approx. wt./ft. (lbs.)	Minimum breaking force (tons of 2,000 lbs.)		
		IPS	XIP®		IPS	XIP®	XXIP®
3/16	0.059	1.55	1.71				
1/4	0.105	2.74	3.02	0.116	2.94	3.40	
5/16	0.164	4.26	4.69	0.18	4.58	5.27	
3/8	0.236	6.10	6.72	0.26	6.56	7.55	8.30
7/16	0.32	8.27	9.10	0.35	8.89	10.2	11.2
1/2	0.42	10.7	11.8	0.46	11.5	13.3	14.6
9/16	0.53	13.5	14.9	0.59	14.5	16.8	18.5
5/8	0.66	16.7	18.3	0.72	17.9	20.6	22.7
3/4	0.95	23.8	26.2	1.04	25.6	29.4	32.4
7/8	1.29	32.2	35.4	1.42	34.6	39.8	43.8
1	1.68	41.8	46.0	1.85	44.9	51.7	56.9
1 1/8	2.13	52.6	57.8	2.34	56.5	65.0	71.5
1 1/4	2.63	64.6	71.1	2.89	69.4	79.9	87.9
1 3/8	3.18	77.7	85.5	3.50	83.5	96.0	106
1 1/2	3.78	92.0	101	4.16	98.9	114	125
1 5/8	4.44	107	118	4.88	115	132	146
1 3/4	5.15	124	137	5.67	133	153	169
1 7/8	5.91	141	156	6.50	152	174	192
2	6.72	160	176	7.39	172	198	217
2 1/8	7.59	179	197	8.35	192	221	244
2 1/4	8.51	200	220	9.36	215	247	272
2 3/8				10.4	239	274	
2 1/2				11.6	262	302	
2 5/8				12.8	288	331	
2 3/4				14.0	314	361	
2 7/8				15.3	341	392	
3				16.6	370	425	
3 1/8				18.0	399	458	
3 1/4				19.5	429	492	
3 3/8				21.0	459	529	
3 1/2				22.7	491	564	
3 5/8				24.3	523	602	
3 3/4				26.0	557	641	
3 7/8				27.7	591	680	
4				29.6	627	720	
4 1/8				31.7	658	757	
4 1/4				33.3	694	799	
4 3/8				35.4	734	844	

Available galvanized at 10% lower strengths, or in equivalent strengths on special request.



Rotation-resistant and low-torque ropes

Rotation-resistant ropes can frequently provide the best and most economical service in specific applications when you choose, handle and use them properly.

USE EXTRA CARE

> The very nature of rotation-resistant ropes requires special handling, selection and usage.

Contra-helically laid, rotation-resistant ropes are different from standard ropes because they're designed to reduce rope torque. Modes of failure and wear for rotation-resistant ropes can differ from those for standard rope constructions. The very nature of these ropes requires special handling, selection and usage. They are more susceptible to kinking, crushing and unbalancing in the form of "core pops" and "birdcages." Use extreme care to avoid operational practices that can possibly lead to these conditions.

THERE ARE DIFFERENT TYPES OF ROTATION-RESISTANT ROPES IN ASTM A1023, CATEGORIZED BY THEIR RESISTANCE TO ROTATION.

CATEGORY 1 ROTATION-RESISTANT ROPE
– has at least 15 outer strands, has three layers of strands (over a center) and has little or no tendency to rotate, or, if guided, transmits little or no torque.

Because Category 1 rotation resistant ropes are manufactured with little or no preforming, it is critical to not remove the welded ends. If the welded ends are removed the rope can become unbalanced.

CATEGORY 2 ROTATION-RESISTANT ROPE
– has 10 or more outer strands, has two or more layers of strands (over a center) and has a significant resistance to rotation.

CATEGORY 3 ROTATION-RESISTANT ROPE
– has no more than 9 outer strands, has two layers of strands (over a center) and has limited resistance to rotation. For best performance, Category 2 and 3 rotation resistant ropes should not be used with a swivel. Category 1 rotation-resistant rope may be used with a swivel.

Because rotation-resistant ropes are special, there are separate design, maintenance, inspection and removal criteria established for them in many industry regulations and standards. Rotation-resistant ropes must be replaced when you see two randomly distributed crown wire breaks in six rope diameters – or four randomly distributed crown wire breaks in 30 rope diameters. If any significant reduction in diameter is found in a short length of a rotation-resistant rope, the rope needs to be replaced.

Rotation-resistant ropes must be used with a minimum design factor of 5.0.

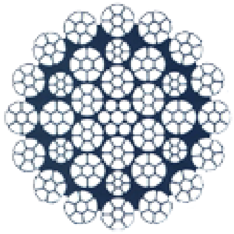
STARLIFT XTRA™

Starlift Xtra, a Category 1 rotation-resistant rope, features a unique design that minimizes the torque and rotation of the rope at normal load ranges of zero to 20% of the rope's minimum breaking force (MBF). In addition, Starlift Xtra is engineered to give you maximum strength per diameter while also achieving superior fatigue resistance. These factors combine to give you the maximum service life when you have long block falls or load control is critical. Unlike other rotation-resistant ropes, swivels can be used in your system with Starlift Xtra.

Starlift Xtra wire rope has one of the highest strength-to-diameter ratios on the market. ASME B30.5 Mobile and Locomotive Cranes requires a design factor of 3.5 for 6-strand hoist ropes.

The same standard requires a design factor of 5.0 for rotation-resistant ropes. The MBF of Starlift Xtra is such that even with the 5.0 design factor, it has lifting capacities that equal or exceed 6-strand XIP ropes utilizing a 3.5 design factor. Other ropes of similar construction do not provide this benefit.

The characteristics of Starlift Xtra enhance its performance in multiple-layer spooling as well. The lang lay construction, coupled with the special design features, provide excellent resistance to abrasion that occurs at kickover areas in drum spooling. The rope construction combined with the compacted strand design of Starlift Xtra results in a rope cross-section of very high density. This feature provides increased resistance to crushing.

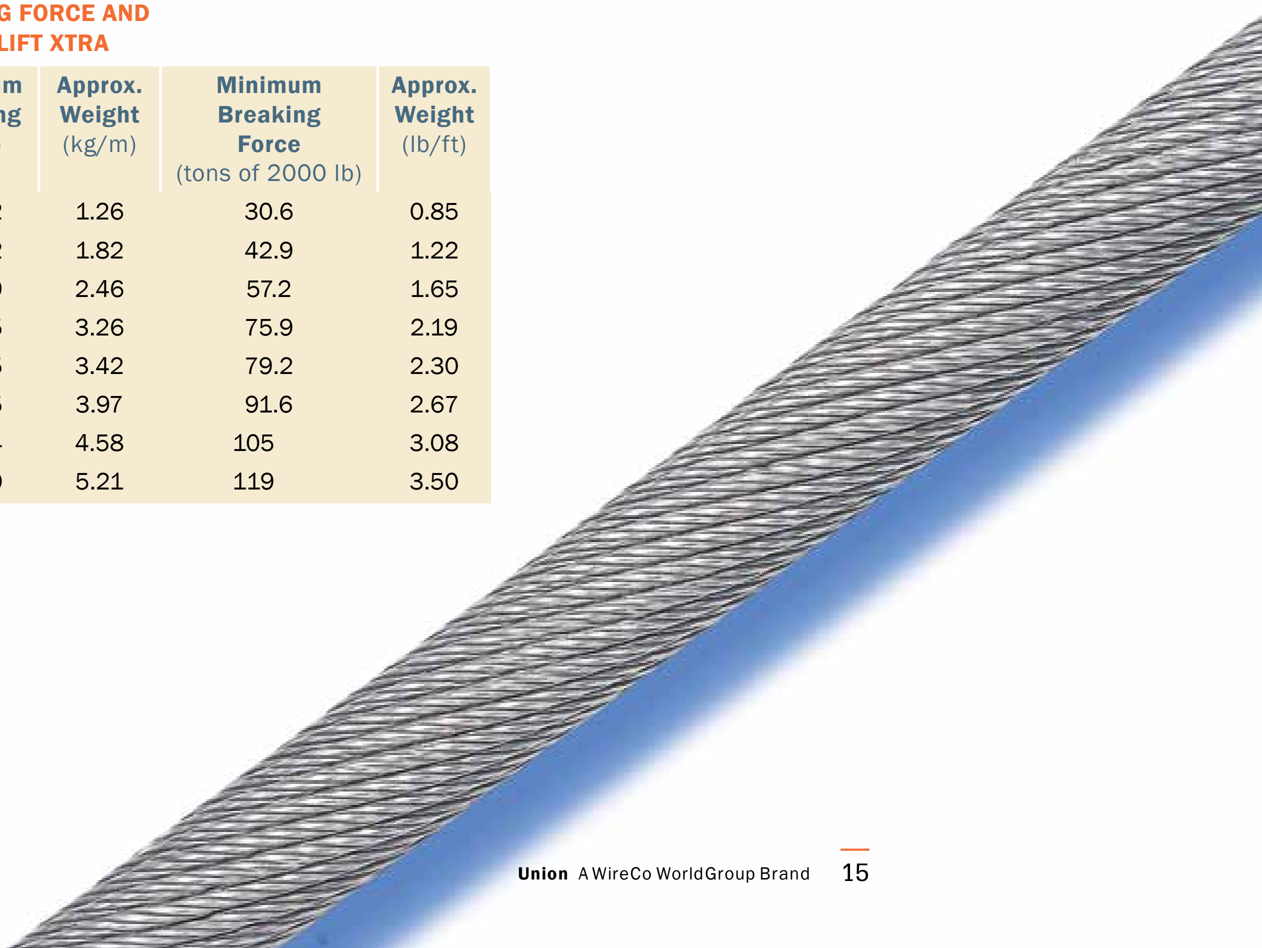


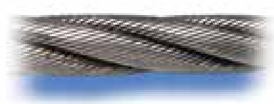
STARLIFT XTRA

> A Category 1 rotation-resistant rope, features a unique design that minimizes the torque and rotation of the rope at normal load ranges of zero to 20% of the rope's minimum breaking force.

MINIMUM BREAKING FORCE AND WEIGHTS FOR STARLIFT XTRA

Diameter (mm)	Minimum Breaking Force (kN)	Approx. Weight (kg/m)	Minimum Breaking Force (tons of 2000 lb)	Approx. Weight (lb/ft)
16	272	1.26	30.6	0.85
19	382	1.82	42.9	1.22
22	509	2.46	57.2	1.65
25.4	675	3.26	75.9	2.19
26	705	3.42	79.2	2.30
28	815	3.97	91.6	2.67
30	934	4.58	105	3.08
32	1.060	5.21	119	3.50

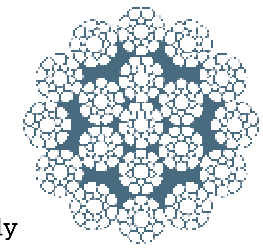




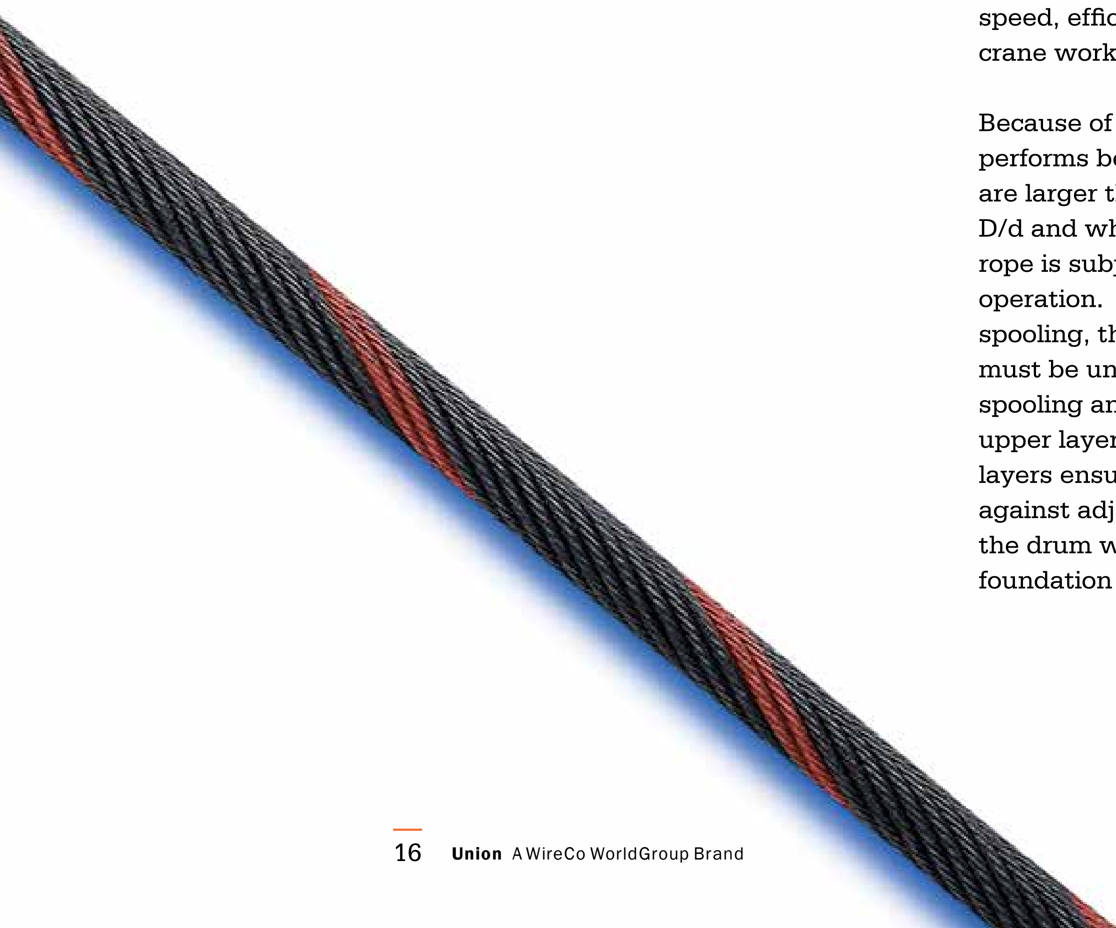
> With its unique design, XLT⁴ brings more high-tensile steel into the rope's diameter, resulting in one of the highest strength-to-diameter ratios.

FLEX-X® 19

Flex-X 19, a Category 2 rotation-resistant rope, is made from 19 strands. Six strands are laid around a core strand in one direction, and then 12 strands are laid around this first operation in the opposite direction. Because of its tightly compacted smooth design, Flex-X 19 offers more crushing resistance than standard 19 x 7 rope, higher strength- to-diameter, resistance to bending fatigue, exceptional stability, reduced wear to sheaves and drums, and improved handling, operating and spooling characteristics.



Flex-X 19 has also demonstrated greater fatigue resistance to substantially cut rope expense and extend service life. It's ideal for multi-part hoist lines wherever you encounter spooling problems, drum crushing, block twisting or have fast line speeds.

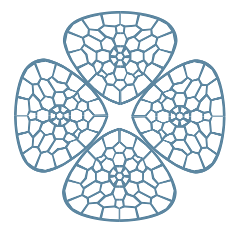


XLT4

XLT4 ropes are specially designed to provide very low torque, a high minimum breaking force and high resistance to wear in multi-layer spooling.

Under load, XLT4 generates near-zero torque, matching or surpassing the stability of Category 1 35 x 7 class rotation-resistant ropes. Yet, thanks to its unique design, XLT4 is not classified as a "rotation-resistant" rope. It can be used with or without a swivel as a mobile crane hoist rope at design factors as low as 3.5 to 1.

XLT4 rope's compact construction keeps more steel in contact with sheaves and drums for unmatched resistance to crushing and wear – for lower maintenance, less downtime and longer service life. With the rope's high capacity, lifts may be feasible using fewer parts of line – boosting the speed, efficiency and productivity of crane work.



Because of its unique construction, XLT4 performs best on grooved drums that are larger than the minimum required D/d and where the entire length of the rope is subjected to loading in normal operation. Where there is multiple layer spooling, the base layers on the drum must be under tension to assure proper spooling and to avoid "pull-in" of the upper layers. The tension on these lower layers ensures that the rope is both tight against adjacent wraps and tight around the drum which establishes a solid foundation for the upper layers.

MINIMUM BREAKING FORCE AND WEIGHTS FOR ROTATION-RESISTANT AND LOW TORQUE CRANE ROPES

	FLEX-X® 19		XLT4™		19 X 7 XIP®		8 X 25 XIP®	
Diameter (in.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)*	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)*	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)*
3/16					0.064	1.57		
1/4					0.113	2.77		
5/16					0.177	4.30	0.18	4.63
3/8					0.25	6.15	0.26	6.63
7/16	0.43	11.2			0.35	8.33	0.36	8.97
1/2	0.49	14.6	0.51	17.7	0.45	10.8	0.47	11.6
9/16	0.65	18.5	0.65	22.3	0.58	13.6	0.60	14.7
5/8	0.78	22.7	0.79	27.4	0.71	16.8	0.73	18.1
3/4	1.16	32.4	1.1	39.2	1.02	24.0	1.06	25.9
7/8	1.58	43.8	1.5	53	1.39	32.5	1.44	35.0
1	2.05	56.9	2.1	68.9	1.82	42.2	1.88	45.5
1 1/8	2.57	71.5	2.6	86.7	2.30	53.1	2.39	57.3
1 1/4					2.83	65.1	2.94	70.5
1 3/8					3.43	78.4	3.56	84.9
1 1/2					4.08	92.8	4.24	100

*The minimum breaking force applies only when a test is conducted with both ends fixed. When in use, the minimum breaking force of these ropes may be significantly reduced if one end is free to rotate.

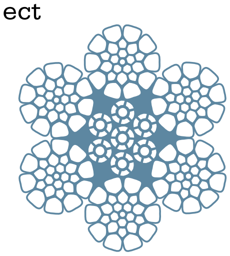
Premium value ropes

FLEX-X AND INCREASED SURFACE AREA

> Flex-X ropes provide greater surface area and more steel per given diameter, increasing rope stability, strength – and service life.

FLEX-X® 6

Most applications for wire rope are extremely demanding. Wire rope must resist crushing, bending fatigue and abrasion. For example, clamshell closing lines must resist bending fatigue and boom hoists are subject to pressures that cause crushing. Overhead hoists test the stability and strength of a wire rope. All drum-related applications demand a rope that will spool and operate smoothly and dependably.

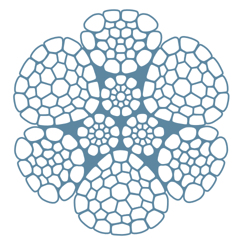


Flex-X 6 users receive superior performance and increased service life in many applications compared to the ropes they had previously employed. When compared to conventional 6 strand ropes, Flex-X 6 ropes provide greater surface area and more steel per given diameter, which increases rope stability and strength, too. This results in longer service life and less sheave and drum wear.

FLEX-X® 9

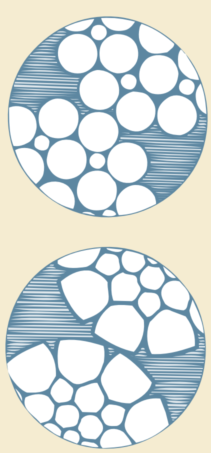
Designed to combat drum crushing challenges in boom hoisting applications, Flex-X 9 features compacted strands and swaging for extra drum crushing resistance and increased stability. Its high-density strands deliver extra strength, surprising bendability and a stubborn resistance to abrasion.

Flex-X 9 is manufactured with a dual compaction process to produce a compact cross-section with minimum voids and greater surface area on outer wires that contact drums, sheaves and the rope, itself, during operation. The high-density, compacted strands minimize nicking at strand-to-strand contact points.



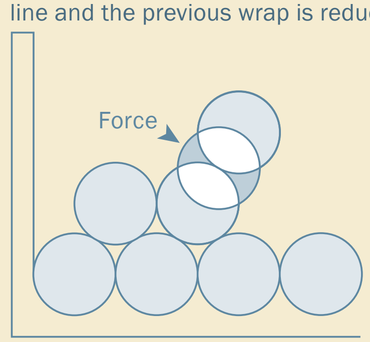
And Flex-X 9 makes inspection easier for you. While standard swaged ropes may develop internal broken wires before they do externally, Flex-X 9's design minimizes internal stresses, making external wire breaks more likely to develop first.

FLEX-X VS STANDARD 6 X 26 WS



The increased surface area of Flex-X can be seen in the comparison of the contact points of a standard 6 x 26 WS (top) and Flex-X (bottom).

Drum scrubbing between the lead line and the previous wrap is reduced.



Smooth contact creates less interference, less metal loss and wire deformation.

MINIMUM BREAKING FORCE AND WEIGHTS FOR FLEX-X 6 AND FLEX-X 9

	FLEX-X® 6		FLEX-X® 9	
Diameter (in.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)
3/8	0.32	8.8		
7/16	0.41	11.9		
1/2	0.55	15.3		
9/16	0.70	19.3		
5/8	0.86	22.7	0.90	26.2
3/4	1.25	32.4	1.30	37.4
7/8	1.67	43.8	1.79	50.6
1	2.18	56.9	2.33	65.7
1 1/8	2.71	71.5	2.93	82.7
1 1/4	3.43	87.9		
1 3/8	4.25	106		
1 1/2	5.01	125		

POLYMER PENETRATION

> With one strand and part of the polymer plastic removed, you can see how deep the polymer penetrates into the rope, giving you uniform and continuous support for all strands throughout the length of the rope.

PFV®

PFV, the plastic-impregnated wire rope, has proven in many applications to give you longer service life and cleaner operation than conventional wire ropes.

On the inside, you'll find our top-of-the-line wire rope that effectively withstands the tough pressures of your demanding jobs. On the outside, you'll see a specially engineered polymer plastic designed to overcome even harsher conditions. This polymer is applied at high pressure to force the material into the rope, filling the valleys of the strands.

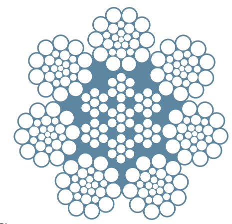
PFV cushions the strands, distributes internal stresses, keeps in wire rope lubricant and keeps out dirt and debris.

PFV doesn't melt or soften from the heat of normal operating temperatures. It's also virtually unaffected by sunlight and cold weather. The result is longer service life from your wire rope.

PFV also helps shed water and dirt, giving you a clean, smooth surface to make it easy to pass over sheaves and onto drums. This smooth surface works to clean and polish as it extends the service life of your sheaves and drums, while also reducing your cleanup requirements and your maintenance costs.

7-FLEX®

We offer 7-Flex ropes for many applications that currently use 6 x 19 or 6 x 36 classification ropes. Their operating characteristics are similar in many ways to 6 x 36 classification ropes. Typical applications such as container cranes, logging portal cranes and sawmill carriages have reported increased service life with the 7-Flex rope.



The 7-Flex construction offers improved resistance to bending fatigue compared to a 6 x 26 due to a combination of the outer wire size and the seventh strand. These products are also available in a PFV option to further enhance service.

MINIMUM BREAKING FORCE AND WEIGHTS FOR ALL 7-FLEX ROPES

Diameter (in.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.) **XIP®IWRC**
3/8	0.26	7.55
7/16	0.35	10.2
1/2	0.46	13.3
9/16	0.59	16.8
5/8	0.72	20.6
3/4	1.04	29.4
7/8	1.42	39.8
1	1.85	51.7
1 1/8	2.34	65.0
1 1/4	2.89	79.9

FLEX-X® 7 CC

Container crane hoist and trolley ropes are subjected to the stressful combination of bending fatigue and abrasion from operating over a series of intricate sheaves and drums. Flex-X 7 CC is a wire rope for container cranes that's so revolutionary it's guaranteed to provide you with a significant lift in service life when compared with standard ropes.

Flex-X 7 CC will operate longer – no matter what load conditions you put it under. A combination of superior design and manufacturing technique helps reduce metal fatigue, internally and externally,
while helping to extend the life of sheaves and drums.

In addition to container crane applications, Flex-X 7 CC is now providing extended service life in carriage operations and other applications where multi-sheave equipment and rigorous duty cycles induce fatigue stresses. Almost any application currently using a 6 x 36 construction can gain an increase in service life with Flex-X 7 CC.

Fatigue tests have shown that Flex-X 7 CC will outperform competitors' premium 8-strand compacted, coated core ropes by 60% or more. These tests have also shown that Flex-X 7 CC outlasts standard ropes by up to 88%.

MINIMUM BREAKING FORCE AND WEIGHTS FOR FLEX-X 7 CC

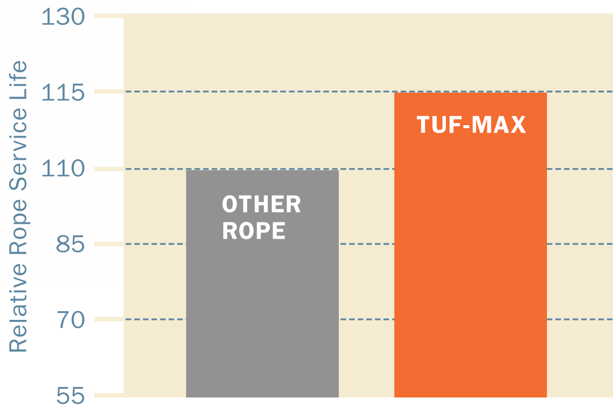
Diameter (in.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.) **IWRC**
1/2	0.50	15.3
9/16	0.63	19.3
5/8	0.80	22.7
3/4	1.13	32.4
7/8	1.55	43.8
1	2.01	56.9
1 1/8	2.54	71.5
1 1/4	3.14	87.9
1 3/8	3.80	106
1 1/2	4.43	125

Mining wire ropes

TUF-MAX® SHOVEL ROPES

TUF-MAX shovel ropes are the latest development in PFV® mining rope technology. These 8-strand ropes utilize improved design and enhanced application and formulation of the polymer plastic to achieve superior performance for shovel hoist applications. Field tests have shown up to 20% or more increases in service life when compared to other premium shovel hoist ropes.

STUDY OF HOIST ROPES ON A FLEET OF 4100s, 2800s AND 495s IN INTERNATIONAL COPPER MINES



POWERMAX™ DRAG AND HOIST ROPES

PowerMax, an 8-strand rope, provides operating characteristics essential to drag and hoist ropes. Proprietary WireCo WorldGroup metallurgy was utilized in the development of special rod chemistry requirements to provide optimum wire characteristics for mining ropes.

With eight outer strands, PowerMax is more fatigue resistant than 6-strand ropes of the same diameter, plus, its greater surface area puts more steel in touch with contact surfaces reducing wear and abrasion.

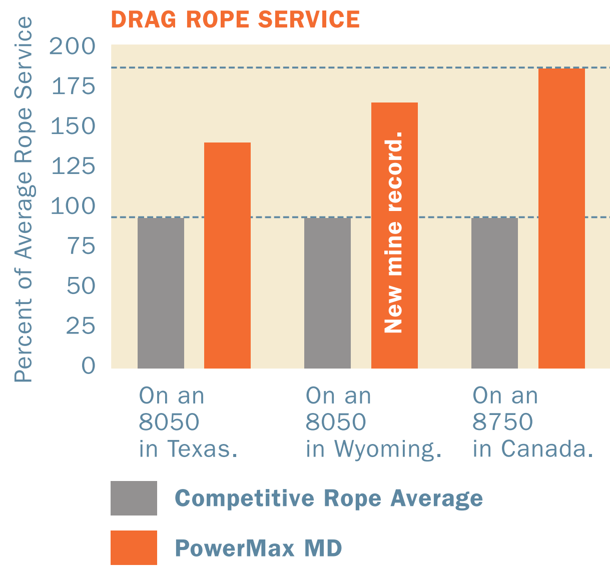
Just as importantly, no drag or hoist rope available is subjected to more rigorous standards of manufacturing than PowerMax.

POWERMAX MD™ DRAG ROPES

PowerMax MD is a unique new drag rope, designed specifically for exceptional performance and extended service life on draglines with reverse bend fairlead systems. Built around a plastic-impregnated independent wire rope core (IWRC) are eight compacted strands of cold-drawn, high-carbon steel wires, a construction that delivers the optimal combination of strength and resistance to bending fatigue and abrasion.

With eight outer strands fortifying the compacted-strand design of PowerMax MD, this rope delivers approximately 10% higher minimum breaking strength than the standard 6-strand drag ropes. It also supplies the ability to handle the bending stresses at the fairleads.

DRAG ROPE SERVICE



Flattened strand ropes/6 x 7 classification sandlines

Also called triangular strand, flattened strand ropes perform exceptionally well on certain installations, especially those involving heavy loads where the speed of operation is slow, where adequate diameter sheaves and drums are used, or where a crush resistant rope is required. Typical installations include skip hoists, large overhead cranes, boom hoist ropes and mine shaft hoists.

Their distinguishing physical feature is their relatively flat exposed surfaces of strands. As a result, the rope exterior is more nearly a smooth, continuous circle than that of regular round strand wire rope. Flattened strand ropes are made with two layers of 12 wires around a triangular-shaped center. We offer a 6 x 30 Style G using a six-wire center as the standard construction.

THE ADVANTAGES OF FLATTENED STRAND ROPES

The flattened shape forms a bearing surface with more contact points on each strand than a round strand rope. With more sheave contact, weight and wear on the rope are distributed more uniformly than on a typical round strand rope. The triangular strand structure also results in more steel in the cross-section than a standard round strand rope of equal size.

MINIMUM BREAKING FORCE AND WEIGHTS FOR FLATTENED STRAND XIP ROPES

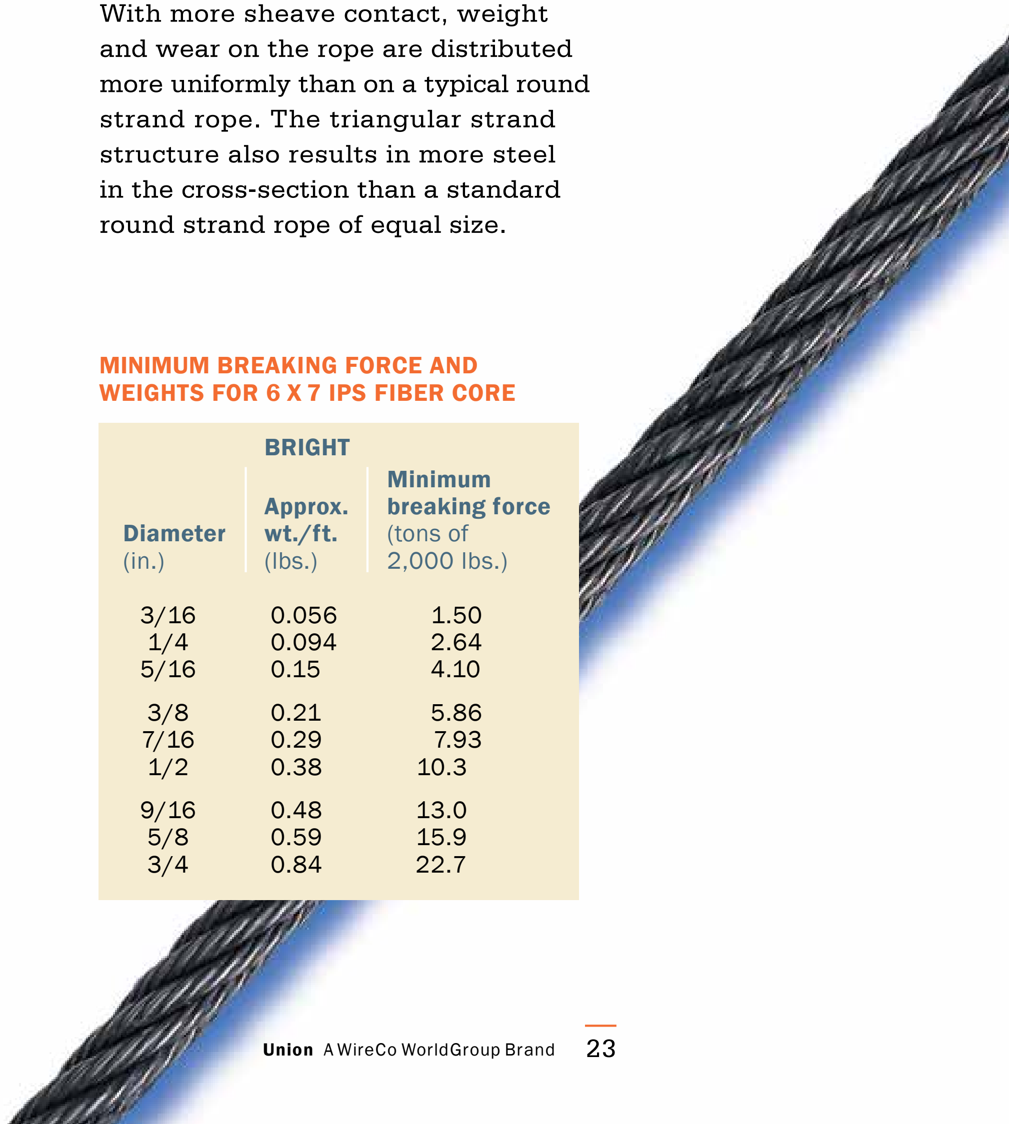
	FIBER CORE		IWRC	
Diameter (in.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)
5/8	0.70	20.1	0.74	21.7
3/4	1.01	28.8	1.06	31.0
7/8	1.39	39.0	1.46	41.9
1	1.80	50.6	1.89	54.4
1 1/8	2.28	63.7	2.39	68.5
1 1/4	2.81	78.2	2.95	84
1 3/8	3.40	93.9	3.57	101
1 1/2	4.05	111	4.25	119
1 5/8	4.75	130	4.99	140
1 3/4	5.51	151	5.79	161

6 X 7 CLASSIFICATION SANDLINES

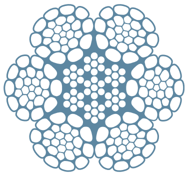
In a 6 x 7 rope, the wires are larger than those of other constructions of the same diameter. Wires of a 6 x 7 are approximately twice the diameter of outer wires of a 6 x 25 FW rope. The large size of the outer wires gives this class excellent abrasion resistance – at great sacrifice of bendability and resistance to fatigue. The standard 6 x 7 rope construction is made with fiber core and right regular lay.

MINIMUM BREAKING FORCE AND WEIGHTS FOR 6 X 7 IPS FIBER CORE

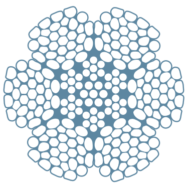
	BRIGHT	
Diameter (in.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)
3/16	0.056	1.50
1/4	0.094	2.64
5/16	0.15	4.10
3/8	0.21	5.86
7/16	0.29	7.93
1/2	0.38	10.3
9/16	0.48	13.0
5/8	0.59	15.9
3/4	0.84	22.7



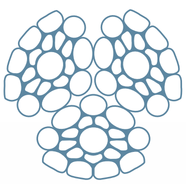
Swaged wire ropes



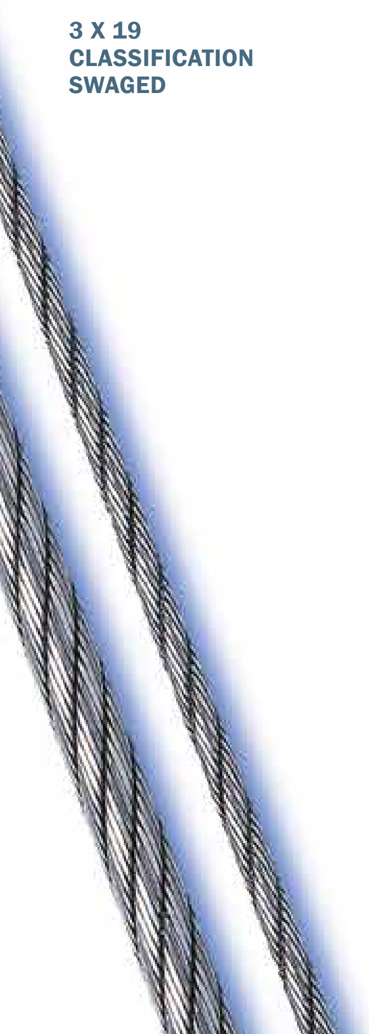
6 X 19 CLASSIFICATION SWAGED



6 X 36 CLASSIFICATION SWAGED



3 X 19 CLASSIFICATION SWAGED



6 X 19 AND 6 X 36 CLASSIFICATION SWAGED WIRE ROPE

These ropes offer greater strength than standard ropes of the same diameter while providing greater resistance to drum crushing, scrubbing and similar surface wear. To enhance the performance of our swaged ropes in the field, we utilize a special wire chemistry in the outer wires of the strands. Then during production, the rope is rotary swaged to produce a compact cross-section with minimum voids and greater surface area on outer wires. In addition to reducing rope surface wear, this compact design helps reduce wear to sheaves and minimizes crushing of the rope on the drum.

MINIMUM BREAKING FORCE AND WEIGHTS FOR 6 X 19 CLASSIFICATION AND 6 X 36 CLASSIFICATION SWAGED WIRE ROPES

Diameter (in.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)
1/2	0.55	16.0
9/16	0.71	20.2
5/8	0.96	24.7
3/4	1.32	35.3
7/8	1.70	47.8
1	2.22	62.0
1 1/8	2.66	79.3
1 1/4	3.47	97.5
1 3/8	4.20	117

POWERFLEX®

Simetimes referred to as “double-swaged” in the industry, PowerFlex is compacted not once, but twice, to yield excellent strength for your logging applications. PowerFlex works hard to lift your heavy loads while resisting drum crushing and giving you better spooling performance, with greater resistance to stretch.

PowerFlex keeps its structural integrity and its size to add longer service life to your logging wire ropes.

MINIMUM BREAKING FORCE AND WEIGHTS FOR POWERFLEX ROPES

Diameter (in.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)
9/16	0.83	24.0
5/8	1.0	28.0
3/4	1.5	43.0
7/8	2.1	57.5
1	2.7	75.5
1 1/8	3.5	93.0

3 X 19 AND 3 X 36 CLASSIFICATION SWAGED WIRE ROPE

These 3 strand ropes are ideal for pulling lines in electrical transmission line construction. Rotary swaging the rope results in an exceptionally compact rope cross-section. This increases surface area, which improves rope contact with sheaves and on drums, thereby providing greater resistance to surface wear and abrasion while reducing wear on sheaves. The smooth surface also helps reduce wear on underground conduits. Lengths may be fitted with flemish-eye ends.

MINIMUM BREAKING FORCE AND WEIGHTS FOR 3 X 19 CLASSIFICATION AND 3 X 36 CLASSIFICATION SWAGED WIRE ROPES

Diameter (in.)	**Approx. wt./ft.** (lbs.)	**Minimum breaking force** (tons of 2,000 lbs.)
3/16*	0.074	2.14
1/4*	0.131	3.77
5/16	0.205	5.86
3/8	0.30	8.39
1/2	0.53	14.8
9/16	0.66	18.6
5/8	0.83	22.9
3/4	1.19	32.7
7/8	1.69	45.3
1	2.09	57.5

*Made in 3 x 7 construction.

Specialty small ropes

This category includes wire ropes in sizes as small as 1/32" in diameter. They're used in a variety of applications, including control cables, window and door closures, different kinds of remote control systems, boat rigging and others.

They can be made of galvanized or stainless steel aircraft wire.

Each of these products is carefully engineered and fabricated to uniform size and quality. For example, 1/16" 7 x 19 contains 133 separate wires, making the wires approximately the diameter of a human hair. Yet the rope has high strength, bendability and fatigue resistance.

These ropes are produced for the most common applications in the market. Utility grade is made to ASTM A1023. These cables have historically been called "aircraft" cable. Since most applications do not require that designation, we changed the name to "utility" cable. We are on the Qualified Producers List (QPL) and can provide these ropes to the MIL-DTL-83420 "aircraft" specifications on request. They require special lubrication, internal marking and fatigue testing.

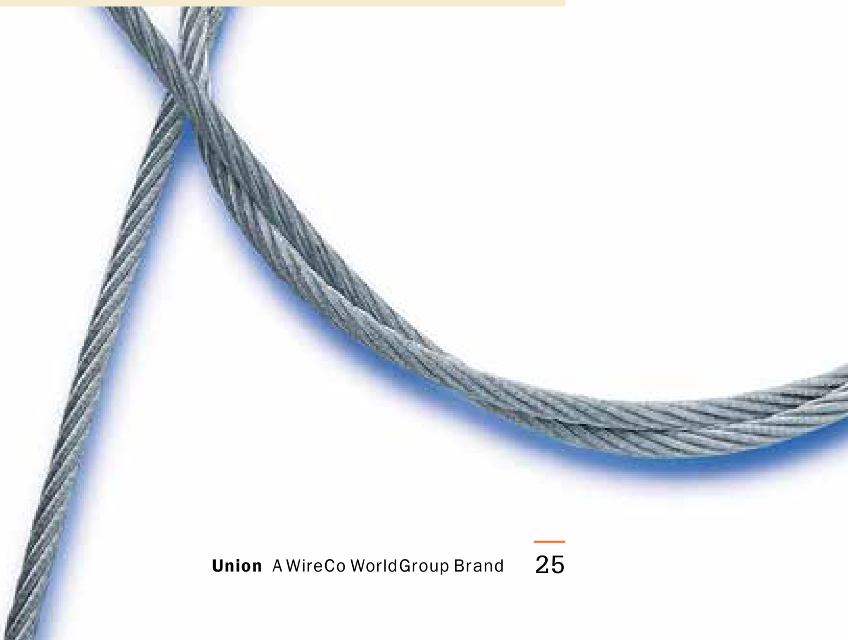
MINIMUM BREAKING FORCE AND WEIGHTS FOR 7 X 7 UTILITY CABLE - GALVANIZED OR STAINLESS

Diameter (in.)	Approx. wt./100 ft. (lbs.)	Minimum breaking force (lbs.)	
		GALVANIZED	STAINLESS
1/32*	0.16	110	110
3/64	0.42	270	270
1/16	0.75	480	480
5/64	1.1	650	650
3/32	1.6	920	920
7/64	2.2	1,260	1,260
1/8	2.8	1,700	1,700
5/32	4.3	2,600	2,400
3/16	6.2	3,700	3,700
7/32	8.3	4,800	4,800
1/4	10.6	6,100	6,100
9/32	13.4	7,600	7,600
5/16	16.7	9,200	9,000
3/8	23.6	13,100	12,000

*1/32 is made in 3 x 7 construction.

MINIMUM BREAKING FORCE AND WEIGHTS FOR 7 X 19 UTILITY CABLE - GALVANIZED OR STAINLESS

Diameter (in.)	Approx. wt./100 ft. (lbs.)	Minimum breaking force (lbs.)	
		GALVANIZED	STAINLESS
1/16	0.75	480	480
3/32	1.7	1,000	920
7/64	2.2	1,400	1,260
1/8	2.9	2,000	1,760
5/32	4.5	2,800	2,400
3/16	6.5	4,200	3,700
7/32	8.6	5,600	5,000
1/4	11.0	7,000	6,400
9/32	13.9	8,000	7,800
5/16	17.3	9,800	9,000
11/32	20.7	12,500	–
3/8	24.3	14,400	12,000



Galvanized strand products

Our galvanized strand products meet or exceed ASTM Specifications A475 and ASTM A363. Strands are tested for:

- Minimum breaking strength.
- Elongation (High Strength 5%; Extra High Strength and Utilities Grade 4%).
- Individual wire tolerances.
- Wire coating weight – ASTM Method A90.
- Wire wrap test for coating adherence.
- Wire wrap test for steel ductility.
- Preforming check.

PHYSICAL PROPERTIES OF ZINC-COATED STEEL WIRE STRAND

Nominal diameter of strand (in.)	Number of wires	Nominal diameter of coated wires (in.)	Approx. weight of strand (lbs./1000 ft.)	Minimum breaking strength of strand (lbs.)		
				UTILITIES GRADE	HIGH STRENGTH GRADE	EXTRA-HIGH STRENGTH GRADE
3/16	7	.062	73	–	2,850	3,990
7/32	7	.072	98	–	3,850	5,400
1/4	7	.080	121	–	4,750	6,650
9/32	7	.093	164	–	6,400	8,950
5/16	7	.104	205	–	8,000*	11,200*
3/8	7	.120	273	11,500*	10,800*	15,400*
7/16	7	.145	399	18,000	14,500*	20,800*
1/2	7	.165	517	25,000	18,800*	26,900*
1/2	19	.100	504	–	19,100	26,700
9/16	7	.188	671	–	24,500	35,000
9/16	19	.113	637	–	24,100	33,700
5/8	7	.207	813	–	29,600	42,400
5/8	19	.125	796	–	28,100	40,200
3/4	19	.150	1,155	–	40,800	58,300
7/8	19	.177	1,581	–	55,800	79,700
1	19	.200	2,073	–	73,200	104,500
1 1/8	37	.161	2,691	–	91,600	130,800
1 1/4	37	.179	3,248	–	113,600	162,200

*ASTM A363 (weldless) is also available in these sizes and grades upon request.

Wire rope end treatments

PREPARATION FOR INSTALLATION

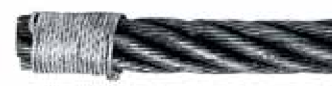
Most ropes are shipped with the ends seized as they are prepared for cutting. You can usually install seized ropes without further preparation. In some cases, though, tight openings in drums and wedge sockets – or even complicated reeving systems – require special end preparation. Then, the strands must be tightly held without increasing the rope diameter. In such cases, the ends are tapered and welded, or the ends fused. It's sometimes necessary to provide a loop or link to which a lighter line is fastened to pull the rope into place or around sheaves. Some of these special end preparations are shown here.

Except for Starlift Xtra, any end preparation that results in the welding or fusing of the rope must be cut off in a manner that leaves the strands and wires free to adjust before you clamp the rope or seat it in an end termination. The welded ends must remain on Starlift Xtra rope.

STEEL END LINK

SEIZED AND TORCH-CUT WITH ENDS FUSED

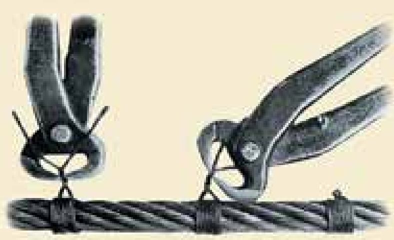
TAPERED AND WELDED END



SEIZED END

TWO TECHNIQUES FOR SEIZING CUT ENDS

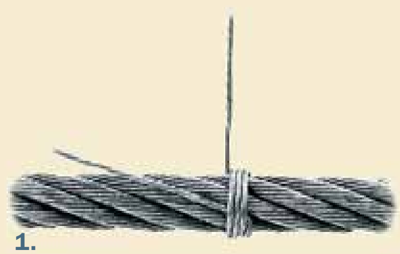
When a rope is to be cut – even though it has been preformed – you should carefully seize it to prevent displacement or relative movement of the wires or strands. You may use either seizing strand, annealed wire or heavy duty tape. The important point is that you must draw the servings down tight to prevent any strand being even slightly displaced. After all the seizings are secure, then you may cut the rope. Normally, one seizing on each side of the cut is sufficient. For non-preformed or rotation-resistant ropes, a minimum of three seizings on each side is recommended. These should be spaced six rope diameters apart.



1. 2. 3.

FIRST METHOD

1. Wind seizing around rope for a length equal to the rope diameter, keeping wraps parallel, close together and in tension. Twist ends of strand together by hand.
2. Continue twisting with pliers to take up slack and tighten.
3. Twist strand tightly against serving, winding twisted strand into knot before cutting off ends of the strand. Pound knot snugly against rope.



1.

2.

SECOND METHOD

1. Lay one end of the seizing in the groove between two strands in the wire rope and wrap the other end tightly over the portion in the groove.
2. Complete steps 2 and 3 at left.

How to extend rope service life

How long will your rope last? There is not a simple answer but, rather, there are several factors involved, including:

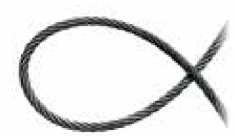
- The manner in which you install and "break in" your new rope.
- The operating technique and work habits of the machine operators.
- Physical maintenance of the rope throughout its service life.
- Physical maintenance of the system in which your rope operates.

RECOMMENDED PRACTICES

We've outlined several recommended practices you may use to extend your rope's useful life. It's also important to note that all sections of this handbook, in some respect, also review ways to help you get greater useful life from your rope, and that's why you need to thoroughly understand all the material here.

INSTALL YOUR ROPE CORRECTLY

The primary concern when installing a new rope is to not trap any twist in the rope system. Proper handling of the rope from the reel or coil to your equipment will help avoid this situation. Another important step on smooth faced drums is to spool with tensioned wraps tight and close together on the first layer. This layer forms the foundation for succeeding layers. Finally, spool the remaining rope on the drum with tension approximating 1% to 2% of the rope's minimum breaking force.



AVOID TWISTING OF NEW WIRE ROPE DURING INSTALLATION

- Handle the rope properly from the reel or coil to your equipment and, on smooth-faced drums, spool with wraps tight and close together on the first layer.

BREAK IN YOUR NEW ROPE PROPERLY

When you install a new operating rope, you should first run it for a brief period of time with no load. Then, for best results, run it under controlled loads and speeds to enable the wires and strands in the rope to adjust to themselves.

"CONSTRUCTIONAL" STRETCH

When first put into service, new ropes normally elongate while strands go through a process of seating with one another and with the rope core. This is called "constructional" stretch because it is inherent in the construction of the rope, and the amount of elongation may vary from one rope to another. For standard ropes, this stretch will be about 1/4% to 1% of the rope's length.

When constructional stretch needs to be minimized, ropes may be factory prestretched. Please specify when placing your order.

Another type of stretch, "elastic" stretch, results from recoverable elongation of the metal itself.

CUT OFF ENDS TO MOVE WEAR POINTS

If you observe wear developing in a localized area, it may be beneficial to cut off short lengths of rope. This may require an original length slightly longer than you normally use. When severe abrasion or numerous fatigue breaks occur near one end or at any one concentrated area – such as drag ropes on draglines or closing lines in clamshell buckets, for example – the movement of this worn section can prolong rope life.

CLEAN AND LUBRICATE REGULARLY TO REDUCE WEAR

We lubricate our wire rope during manufacture so that the strands – as well as the individual wires in the strands – may move and adjust as the rope moves and bends. But no wire rope can be lubricated sufficiently during manufacture to last its entire life. That's why it's important to lubricate periodically throughout the life of the rope.

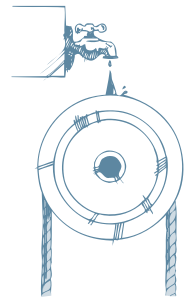
The surface of some ropes may become covered with dirt, rock dust or other material during their operation. This can prevent field-applied lubricants from properly penetrating into the rope, so it's a good practice to clean these ropes before you lubricate them.

The lubricant you apply should be light-bodied enough to penetrate to the rope's core. You can normally apply lubricant by using one of three methods: drip it on rope, spray it on or brush it on. In all cases, you should apply it at a place where the rope is bending such as around a sheave. We recommend you apply it at the top of the bend because that's where the rope's strands are spread by bending and more easily penetrated. In addition, there are pressure lubricators available commercially. Your rope's service life will be directly proportional to the effectiveness of the method you use and the amount of lubricant that reaches the rope's working parts.

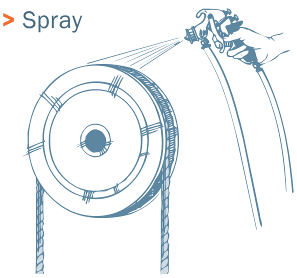
A proper lubricant must reduce friction, protect against corrosion and adhere to every wire. It should also be pliable and not crack or separate when cold – yet not drip when warm. Never apply heavy grease to the rope because it can trap excessive grit, which can damage the rope. Nor should you apply used "engine oil" because it contains materials that can damage the rope. For unusual conditions, you can specify special lubricants that we can apply at the factory.

THREE METHODS OF APPLYING LUBRICATION:

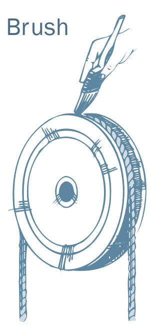
> Drip



> Spray



> Brush



Wire breaks from vibration fatigue occur at end terminations, so short lengths cut off there with reattachment of the socket may prolong the rope's life. When broken wires are found, you should cut off sections of rope. In the case of a socket, you should cut off at least five or six feet. In the case of clips or clamps, you should cut off the entire length covered by them.

Where there is an equalizing sheave, such as that found in many overhead cranes, fatigue is localized at rope tangency points to the equalizing sheave. Rope life may be increased if you shift this point by cutting off a short length at the end of one of the drums. Be sure to make this cutoff before significant wear occurs at the equalizing sheave, and always do so at the same drum. You must maintain the required minimum number of dead wraps on the drum.

REVERSING ENDS

Frequently, the most severe deterioration occurs at a point too far from the end or is too long to allow the worn section to be cut off. In such cases, you may turn the rope end for end to bring a less worn section into the area where conditions are most damaging. This practice is beneficial for incline rope and draglines. The change must be made well before the wear reaches the removal criteria. When changing ends, be careful to avoid kinking or otherwise damaging the rope.

Wire rope inspection

All wire ropes will wear out eventually and gradually lose work capability throughout their service life. That's why periodic inspections are critical. Applicable industry standards such as ASME B30.2 for overhead and gantry cranes or federal regulations such as OSHA refer to specific inspection criteria for varied applications.

THREE PURPOSES FOR INSPECTION

Regular inspection of wire rope and equipment should be performed for three good reasons:

- It reveals the rope's condition and indicates the need for replacement.
- It can indicate if you're using the most suitable type of rope.
- It makes possible the discovery and correction of faults in equipment or operation that can cause costly accelerated rope wear.

HOW OFTEN

All wire ropes should be thoroughly inspected at regular intervals. The longer it has been in service or the more severe the service, the more thoroughly and frequently it should be inspected. Be sure to maintain records of each inspection.

APPOINT A QUALIFIED PERSON TO INSPECT

Inspections should be carried out by a person who has learned through special training or practical experience what to look for and who knows how to judge the importance of any abnormal conditions they may discover. It is the inspector's responsibility to obtain and follow the proper inspection criteria for each application inspected.

For information on inspection methods and techniques, ask us for Techreport 107: Wire Rope Inspection. If you need further assistance with our ropes, contact our Product Engineering Department.

INSPECT YOUR WIRE ROPE REGULARLY

- Inspection should be performed by a person with special training or practical experience.

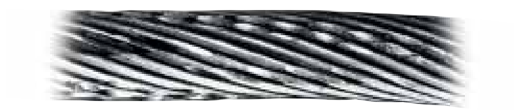
WHAT TO LOOK FOR

Here's what happens when a **wire breaks** under tensile load exceeding its strength. It's typically recognized by the "cup and cone" appearance at the point of failure. The necking down of the wire at the point of failure to form the cup and cone indicates failure has occurred while the wire retained its ductility.

This is a wire with a distinct **fatigue break**. It's recognized by the square end perpendicular to the wire. This break was produced by a torsion machine that's used to measure the ductility. This break is similar to wire failures in the field caused by fatigue.

A wire rope that has been subjected to repeated bending over sheaves under normal loads. This results in **fatigue breaks** in individual wires – these breaks are square and usually in the crown of the strands.

An example of **fatigue failure** of a wire rope subjected to heavy loads over small sheaves. The breaks in the valleys of the strands are caused by "strand nicking." There may be crown breaks, too.



Here you see a single strand removed from a wire rope subjected to **"strand nicking."** This condition is a result of adjacent strands rubbing against one another. While this is normal in a rope's operation, the nicking can be accentuated by high loads, small sheaves or loss of core support. The ultimate result will be individual wire breaks in the valleys of the strands.

Wire rope wear, abuse – and removal criteria

KNOW WHEN TO REMOVE YOUR WIRE ROPE

> The chart on the facing page offers a guide for removal, based on the number of wires involved.

TYPICAL EVIDENCE OF WEAR AND ABUSE

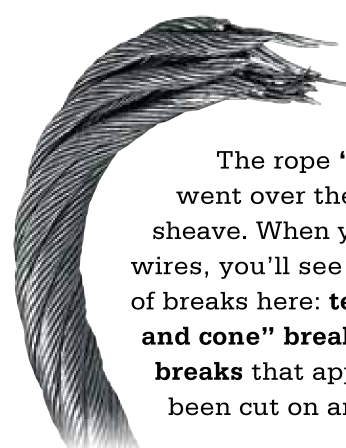
A **"birdcage"** is caused by sudden release of tension and the resulting rebound of rope. These strands and wires will not be returned to their original positions. The rope should be replaced immediately.

A typical failure of a rotary drill line with a poor cutoff practice. These wires have been subjected to continued **peening**, causing fatigue type failures. A predetermined, regularly scheduled cutoff practice can help eliminate this type of problem.

This is **localized wear** over an equalized sheave. The danger here is that it's invisible during the rope's operation, and that's why you need to inspect this portion of an operating rope regularly. The rope should be pulled off the sheave during inspection and bent to check for broken wires.

This is a wire rope with a **high strand** – a condition in which one or more strands are worn before adjoining strands. This is caused by improper socketing or seizing, kinks or dog-legs. At top, you see a closeup of the concentration of wear. At bottom, you see how it recurs every sixth strand in a 6 strand rope.

A **kinked wire rope** is shown here. It's caused by pulling down a loop in a slack line during handling, installation or operation. Note the distortion of the strands and individual wires. This rope must be replaced.



Here's a wire rope that has jumped a sheave. The rope **"curled"** as it went over the edge of the sheave. When you study the wires, you'll see two types of breaks here: **tensile "cup and cone" breaks** and **shear breaks** that appear to have been cut on an angle.

Drum crushing is caused by small drums, high loads and multiple winding conditions.

REMOVAL CRITERIA

A major portion of any wire rope inspection is the detection of broken wires. The number and type of broken wires are an indication of the rope's general condition and a benchmark for its replacement.

Frequent inspections and written records help determine the rate at which wires are breaking. Replace the rope when the values given in the table below are reached.

Valley wire breaks – where the wire fractures between strands or a broken wire protrudes between strands – are treated differently than those that occur on the outer surface of the rope. When there is more than one valley break, replace the rope.

Broken wire removal criteria cited in many standards and specifications, like those listed below, apply to wire ropes operating on steel sheaves and drums. For wire ropes operating on sheaves and drums made with material other than steel, please contact the sheave, drum or equipment manufacturer or a qualified person for proper broken wire removal criteria.

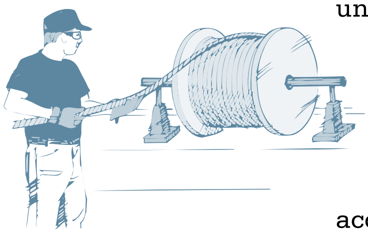
WHEN TO REPLACE WIRE ROPE – BASED ON NUMBER OF WIRES

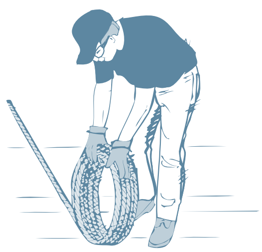
			# OF BROKEN WIRES IN RUNNING ROPES			# OF BROKEN WIRES IN STANDING ROPES	
Standard	Equipment		In one rope lay	In one strand	At end connection	In one rope lay	At end connection
ASME/B30.2	Overhead and gantry cranes		12**	4	Not specified	Not specified	
ASME/B30.3	Tower Cranes	Standard ropes	12**	4	2	Not specified	2
		Rotation-resistant ropes	2 randomly distributed broken wires in 6 rope diameters or 4 randomly distributed broken wires in 30 rope diameters**				
ASME/B30.4	Portal and	Standard Ropes	6**	3	2	Not specified	2
	Pedestal Cranes	Rotation-resistant ropes	4**	2	2	Not specified	2
ASME/B30.5	Mobile and locomotive cranes	Running ropes	6**	3	2	3	2
		Rotation-resistant ropes	2 randomly distributed broken wires in 6 rope diameters or 4 randomly distributed broken wires in 30 rope diameters**				
ASME/B30.6	Derricks		6**	3	2	3	2
ASME/B30.7	Base-mounted drum hoists		6**	3	2	3	2
ASME/B30.8	Floating cranes and derricks		6**	3	2	3	2
ASME/B30.16	Overhead hoists		12**	4	Not specified	Not specified	
ANSI/A10.4	Personnel hoists		6**	3	2	2**	2
ANSI/A10.5	Material hoists		6**	Not specified		Not specified	

**Also remove for 1 valley break.

How to unreel, uncoil and store wire rope

CORRECT WAYS TO UNREEL AND UNCOIL WIRE ROPE





THE RIGHT WAY TO UNREEL AND UNCOIL A WIRE ROPE

There is always a danger of kinking a wire rope if you improperly unreel or uncoil it. You should mount a reel on jacks or a turntable so that it will revolve as you pull the rope off. Apply sufficient tension by means of a board acting as a brake against the reel flange to keep slack from accumulating. With a coil, stand it on edge and roll it in a straight line away from the free end. You may also place a coil on a revolving stand and pull the rope as you would from a reel on a turntable.

HOW TO STORE WIRE ROPE PROPERLY

We recommend you store your wire rope under a roof or a weatherproof covering so that moisture cannot reach it. Similarly, you must avoid acid fumes or any other corrosive atmosphere – including ocean spray – in order to protect the rope from rust. If you're storing a reel for a lengthy period, you may want to order your rope with a protective wrap. If not, at least coat the outer layers of rope with a good rope lubricant.

If you ever take a rope out of service and want to store it for future use, you should place it on a reel after you've thoroughly cleaned and relubricated it. Give the same storage considerations to your used rope as you would your new rope.

Be sure to keep your wire rope in storage away from steam or hot water pipes, heated air ducts or any other source of heat that can thin out lubricant and cause it to drain out of your rope.

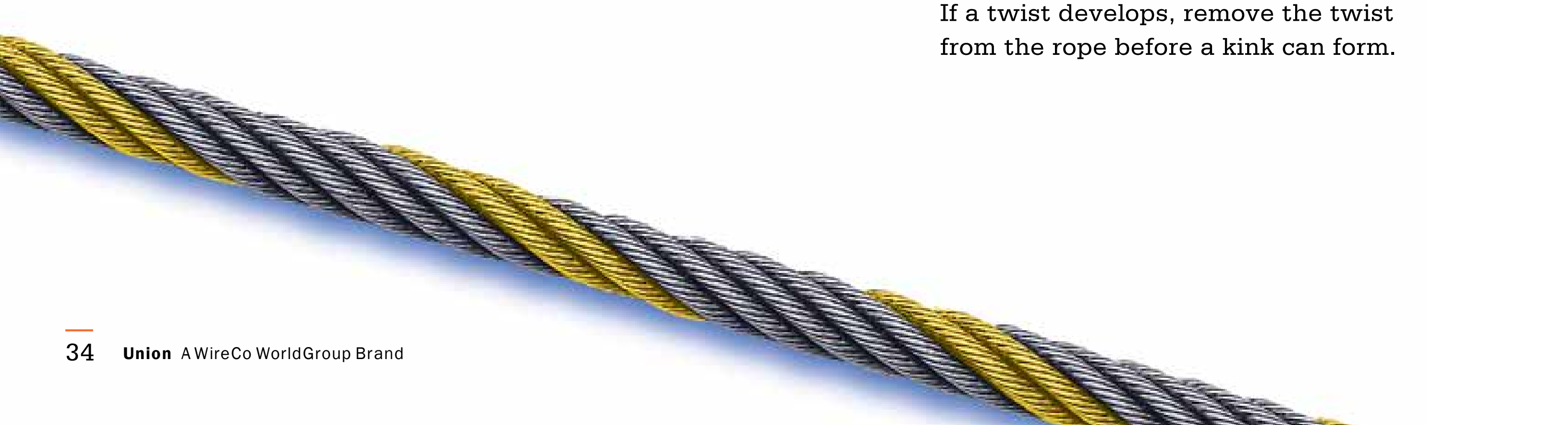
THE THREE STAGES OF KINKING

1. **The start:** A rope should never be allowed to accumulate twist as shown here because it will loop and eventually form a kink. If this loop is removed before being pulled down tight, you can normally avoid the kink.

2. **The kink:** By now, the damage is done, and the rope must not be used.

3. **The result:** Even if the wires do not appear badly damaged, the rope is still damaged and must be replaced.

If a twist develops, remove the twist from the rope before a kink can form.



Wire rope abbreviations

STRAND CONSTRUCTION

S	Seale
W	Warrington
WS	Warrington Seale
F	Filler Wire
SWS	Seale Warrington Seale
SF	Seale Filler Wire
FS	Filler Wire Seale
G	Flattened strand construction with a 6 wire triangular-shaped center

LAYS

SZ	(RR) Right regular
ZS	(LR) Left regular
ZZ	(RL) Right lang
SS	(LL) Left lang

TYPE OF CORE

NFC	Natural fiber core
SFC	Synthetic fiber core
SPC	Solid poly core
WSC	Wire strand core
IWRC	Independent wire rope core
IWRC(K)	IWRC w/compacted strands
EPIWRC	Plastic extruded IWRC

ROPE GRADES

IPS	Improved plow steel
GIPS	Galvanized-to-finished size IPS
DGIPS	Drawn galvanized IPS
XIP®	(EIP) Extra improved plow steel
GXIP®	Galvanized-to-finished size XIP
DGXIP®	Drawn galvanized XIP
XXIP®	(EEIP) Extra extra improved plow steel

ROPE GRADES (continued)

GAC	Galvanized aircraft
GUC	Galvanized utility

WIRE MATERIALS

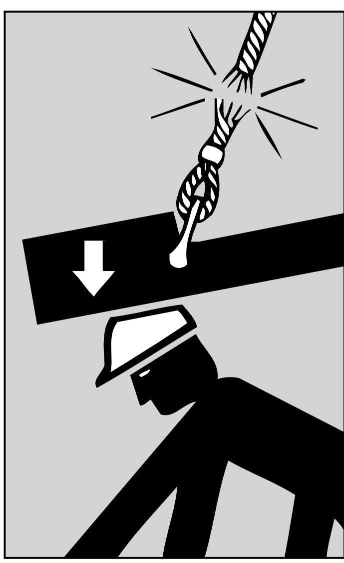
U	Bright or uncoated high carbon steel
B	Drawn galvanized
A	Galvanized-to-finished size

SPECIAL ROPE DESCRIPTIONS

Flex-X® 7 CC	Extended duty crane and hoist rope
PowerMax™	8-strand dragline rope
PowerMax MD™	8-strand dragline rope designed specifically for draglines with reverse bend fairlead systems
Starlift Xtra™	High performance rotation-resistant rope
Flex-X®	Indicates compacted outer strand rope
TUF-MAX®	Special shovel hoist rope with features to increase service life
XLT4™	High strength, low torque wire rope
7-Flex®	Seven strand wire rope
PowerFlex®	Swaged rope with compacted strands; used in logging applications
DPRS	Dynamically pre-stretched
PRS	Statically pre-stretched
L##	Lube code indicating other than standard lubrication
PFV®	Plastic extruded product
PRS PFV®	Statically pre-stretched plastic extruded product
RTY	Rotary drill line
TBG	Tubing line

Warning

In the real world, accidents do happen, and that's why you need to take special precautions. Before installing wire rope in your applications, always read and follow the warning label attached to each product.



⚠ WARNING

Wire rope WILL FAIL if worn-out, overloaded, misused, damaged, improperly maintained or abused.

Wire rope failure may cause serious injury or death!

Protect yourself and others:

- ALWAYS INSPECT wire rope for WEAR, DAMAGE or ABUSE BEFORE USE.
- NEVER USE wire rope that is WORN-OUT, DAMAGED or ABUSED.
- NEVER OVERLOAD a wire rope.
- INFORM YOURSELF: Read and understand manufacturer's literature or *"Wire Rope and Wire Rope Sling Safety Bulletin"*.*
- REFER TO APPLICABLE CODES, STANDARDS and REGULATIONS for INSPECTION REQUIREMENTS and REMOVAL CRITERIA.*

* For additional information or the *BULLETIN*, ask your employer or wire rope supplier.

 Form No. 193

Wire rope glossary

ABRASION Surface wear on the wires of a wire rope.

AIRCRAFT CABLES Strands and wire ropes made of special strength wire primarily for aircraft controls and miscellaneous uses.

ALTERNATE LAY Lay of a wire rope in which the strands are alternately regular and lang lay.

AREA, METALLIC Sum of the cross-sectional areas of individual wires in a wire rope or strand.

BECKET LOOP A loop of small rope or strand fastened to the end of a large wire rope to facilitate installation.

BENDING STRESS Stress imposed on wires of a wire rope by bending.

CABLE-LAID WIRE ROPE A wire rope made of several wire ropes laid into a single wire rope.

CENTERS Wire, strand or fiber in the center of a strand about which the wires are laid.

CLOSING LINE Wire rope that closes a clamshell or orange peel bucket.

COMMON STRAND A grade of galvanized strand.

CONSTRUCTION Design of the wire rope including number of strands, the number of wires per strand and the arrangement of wires in each strand.

CORE The axial member of a wire rope about which the strands are laid. It may be fiber, a wire strand or an independent wire rope.

CORROSION Chemical decomposition of the wires in a rope by exposure to moisture, acids, alkalines or other destructive agents.

CORRUGATED The term used to describe the grooves of a sheave or drum when worn so as to show the impression of a wire rope.

DESIGN FACTOR The ratio of the minimum breaking force to the design maximum working force. The minimum breaking force is the published catalog strength of the wire rope involved, and the design maximum working force is the maximum calculated static load to be applied.

DIAMETER, ROPE The distance measured across the center of a circle circumscribing the strands of a wire rope.

DOG-LEG Permanent short bend in a wire rope caused by improper use.

DRUM A cylindrical flanged barrel, either of uniform or tapering diameter, on which rope is wound either for operation or storage. Its surface may be smooth or grooved.

EFFICIENCY OF WIRE ROPE Percentage ratio of measured breaking strength of a wire rope to the aggregate strength of all individual wires tested separately.

ELASTIC LIMIT Limit of stress above which a permanent deformation occurs.

EQUALIZING SHEAVE The sheave at the center of a rope system over which no rope movement occurs other than equalizing movement. It is frequently overlooked during crane inspections with disastrous consequences. It can be a source of severe degradation.

FATIGUE RESISTANCE The characteristic of a wire rope which allows it to bend repeatedly under stress.

FIBER CORE Rope made of vegetable or synthetic fiber used in the core of a wire rope.

FILLER WIRE A strand construction that has small auxiliary wires for spacing and positioning other wires.

FITTING Any accessory used as an attachment to a wire rope.

FLATTENED STRAND ROPE Wire rope with triangular shaped strands that presents a flattened rope surface.

GRADES, ROPE Classification of wire rope by its minimum breaking force. Common grades in order of increasing minimum breaking force: Improved Plow Steel, Extra Improved Plow Steel, Extra Extra Improved Plow Steel.

GRADES, STRAND Classification of zinc-coated strand by its minimum breaking force. In order of increasing minimum breaking force, they are: Common, Siemens-Martin, High Strength and Extra-High Strength. A Utilities grade strand is also made to meet special requirements.

GROOVED DRUM Drum with a grooved surface to guide the rope for proper winding.

GROOVES Depressions in the periphery of a sheave or drum that are shaped to position and support the rope.

IDLER Sheave or roller used to guide or support a rope.

IMPROVED PLOW STEEL ROPE See “grades, rope.”

INDEPENDENT WIRE ROPE CORE (IWRC) A wire rope used as the core of a larger wire rope.

INNER WIRES All wires of a strand except the outer wires.

IWRC See “Independent Wire Rope Core.”

KINK A sharp bend in a wire rope that permanently distorts the wires and strands; the result of a loop being pulled through.

LANG LAY ROPE Wire rope in which the wires in the strands are laid in the same direction that the strands in the rope are laid.

LAY (1) The manner in which the wires are helically laid into a strand or the strands in a rope, or (2) the length along the rope that one strand uses to make one complete revolution around the core.

LEFT LAY (1) Strand – a rope strand in which the cover wires are laid in a helix having a left-hand pitch, or (2) Rope – a rope in which the strands are laid in a helix having a left-hand pitch.

MARLINE CLAD ROPE A rope with individual strands spirally wrapped with marline or synthetic fiber cord.

MINIMUM BREAKING FORCE Published strength that's been calculated and accepted by the wire rope industry following a set standard procedure. The wire rope manufacturer uses this strength as a minimum strength when designing the wire rope, and the user should consider this to be the strength when making his design calculations.

PEENING Permanent distortion of outside wire in a rope caused by pounding.

PREFORMED WIRE ROPE Wire rope in which the strands are permanently shaped before fabrication into the rope to the helical form they assume in the wire rope.

PREFORMED STRAND Strand in which the wires are permanently shaped before fabrication in the strands to the helical form they assume in the strand.

PRESTRETCHING Stressing a wire rope or strand before use under such a tension and for such a time that the constructional stretch is largely removed.

REEL The flanged spool on which wire rope or strand is wound for storage or shipment.

REGULAR LAY ROPE Wire rope in which the wires in the strands and the strands in the rope are laid in opposite directions.

RESERVE STRENGTH The percentage of the minimum breaking force represented by the inner wires of the outer strands of a wire rope.

RIGHT LAY (1) Strand – a strand in which the cover wires are laid in a helix having a right-hand pitch or (2) Rope – a rope in which the strands are laid in a helix having a right-hand pitch.

ROTATION RESISTANT ROPE A wire rope consisting of an inner layer of strand laid in one direction covered by a layer of strand laid in the opposite direction. This has the effect of reducing torque.

SAND LINE The wire rope that operates the bailer for removing water and drill cuttings in drilling a well.

SEALE A strand construction having one size of cover wires with the same number of one size of wires in the inner layer.

SEIZE To bind securely the end of a wire rope or strand with seizing wire or strand.

SEIZING STRAND Small diameter strand usually of seven wires made of soft annealed iron wire.

SEIZING WIRE A soft annealed iron wire.

SHEAVE A grooved pulley for wire rope.

SLINGS Wire ropes made into forms, with or without fittings, for handling loads and made to permit the attachment of an operating rope.

SMOOTH-FACED DRUM A drum with a plain, ungrooved surface.

SPLICING Interweaving of two ends of ropes so as to make a continuous or endless length without appreciably increasing the diameter. Also making a loop or eye in the end of a rope by tucking the ends of the strands.

STAINLESS STEEL ROPE Wire rope made of chrome-nickel steel wires having resistance to corrosion.

STRAND An arrangement of wires helically laid about an axis, or another wire or fiber center to produce a symmetrical section.

STRENGTH, BREAKING The load, applied through some type of tensile machine, that it takes to pull that piece of rope apart. This is the load at which a tensile failure occurs in the piece of wire rope being tested.

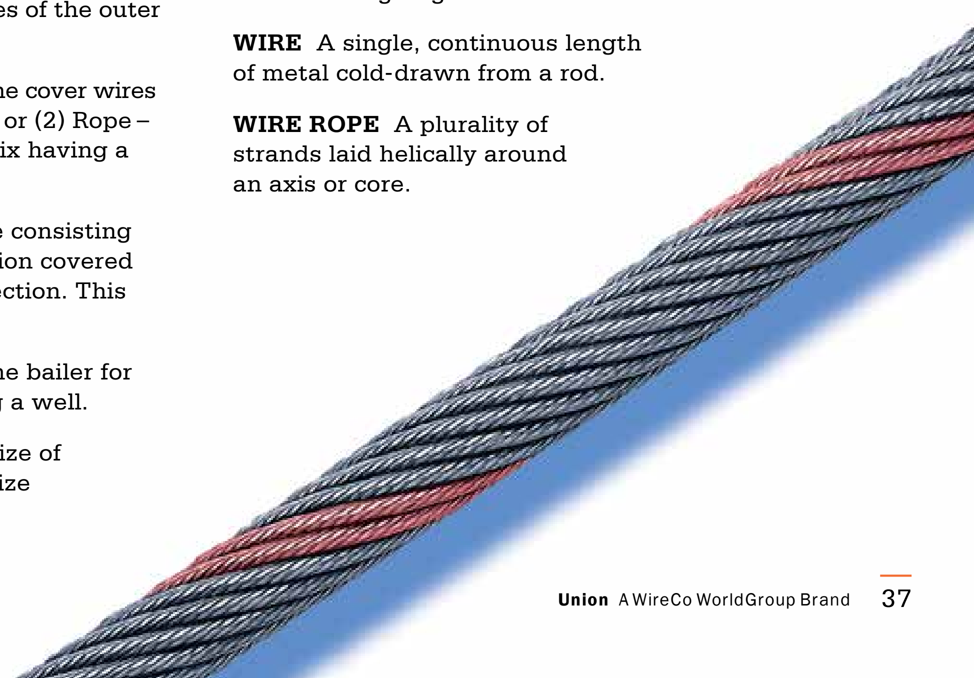
STRENGTH, AGGREGATE The sum of the breaking strength in tension of all the wires of a wire rope when the wires are tested individually.

SWAGED ROPE A wire rope that is rotary-swaged after closing to produce a compact cross-section.

WARRINGTON A strand construction in which the outer layer of wires is composed of alternating large and small wires.

WIRE A single, continuous length of metal cold-drawn from a rod.

WIRE ROPE A plurality of strands laid helically around an axis or core.



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Domestic Wire Rope and Cable

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SRI Quality System Registrar

WARRANTY

Any warranty, expressed or implied as to quality, performance or fitness for use of wire rope products is always premised on the condition that the published strengths apply only to new, unused rope, 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.

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