



Parameter Sample Book

Elevator wire rope

www.gsrgroup.cn

Company overview

GSR is a leading company specializing in research, production, processing, sales, and import-export operations of wire ropes, wires, strands, and related products, equipment, materials, and technologies. The main products include wire ropes, bridge cables, commercial wires, wire rope accessories, and prestressed steel strands. The annual production capacity reaches 600,000 tons. The company excels in producing high-strength, high-toughness, extract, extra-long, special-structure, and special-purpose wire rope products. Therefore, GSR has become a technologically strong, high-capacity and market-leading Chinese industry leader.

For over 50 years, GSR has remained committed to the steel wire rope industry and has taken the initiative to lead its development, assuming both responsibility and mission. The company boasts inherent strengths that include production of various structural steel wire ropes, ranging in diameter 1.0mm to 264mm (reaching 200mm for zinc-aluminum alloy sealed steel wire ropes), as well as PC steel strands ranging in diameter from 5.0mm to 28.6mm, various purpose wires ranging in diameter from 0.15mm to 9.0mm, and deep-processed products such as pretensioned, coated, and rigged steel wire ropes that display high-strength, high-toughness, exceptional thickness, length, and unique structures for special purposes. The "Julong" brand wire ropes produced by GSR are widely used in an array of industries and fields, such as aerospace, national defense construction, building structures, bridge engineering, cable car transport, high-speed elevators, marine engineering, water conservancy engineering, ports, machinery, steel smelting, mining, petroleum drilling and more.

GSR has research platforms such as China National Enterprise Technology Center, China National Torch Program Key High tech Enterprise, High Performance Special Cable Manufacturing Technology and Application National and Local Joint Engineering Research Center, and has undertaken and completed multiple key technological innovation projects in China. The company have independently developed a series of high-tech products, including fully sealed steel wire ropes coated with zinc aluminum rare earth alloy, 264mm large-diameter marine engineering steel wire ropes, large-span bridge steel wire ropes, large electric shovel steel wire ropes, SPC manned steel wire ropes, etc. The technical indicators of these products are higher than the industry technical standards and have reached the international leading level.

The various types of steel wire ropes developed and produced by GSR are widely used in various industries and fields. A large number of difficult and high-tech steel wire rope products have been successfully used in the Gezhouba Water Conservancy Hub Project, Three Gorges Power Station, Shenzhen Yantian Port, Tianjin Port, Guangdong Humen Bridge, Guizhou Baling River Bridge, Beipanjiang Bridge, Hunan Aizhai Bridge, Hong Kong Zhuhai Macao Bridge, Zhenhua 30, the world's largest salvage crane ship, Heidaigou large open-pit coal mine, Kongtong Mountain tourist cableway, Tongren Olympic Sports Center,

Liaoning aircraft carrier Major projects and super projects such as China's "Heavenly Eye" and "Shenzhou" manned spacecraft No. 8, 9, 10, and 11. The company's products are also exported to more than 40 countries and regions in Europe, America, Asia, Africa, Oceania, etc., and have been successfully used in projects such as the Harrogate Bridge in Norway, Maputo Bridge in Mozambique, Heima Coal Mine in Türkiye, Chambishi Mine in Central Africa, Zambia, and Singapore Container Terminal, which are highly recognized in the international market.

GSR has consistently prioritized the strengthening of its technological innovation system and the conversion of its achievements, this makes the company a leader in the industry, and from being an enforcer of rules to a rule-maker. GSR has taken lead and participated in the revision of over 40 international standards, national standards in China, military, and industry standards. In June 2017, the company led the revision of ISO 2408:2017 "Wire ropes - Requirements," an international standard that was published and distributed.

GSR places great importance on the creation, utilization, and protection of intellectual property rights. The company has filed 303 patent technology achievements, which have been accepted by the Chinese National Intellectual Property Administration. Furthermore, GSR has been granted 135 patents.

GSR has obtained ISO 9001 quality management system, ISO 14001 environmental management system, GB/T 01 occupational health and safety management system, ISO 10012 measurement management system, GJB 9001B national military standard quality management system, American Petroleum Institute (API) certification, as well as recognition, certification, and approval from ship classification societies such as CCS, LR, DNV.GL, BV, ABS, KR, among others.

The number of recognitions, certifications, and approvals received by GSR ranks top in the industry. GSR's "Julong" brand wire ropes have been rated as user products for 20 consecutive years. The company is recognized as a AAAA-level "Standardized Good Behavior Enterprise" at the level, a key high-tech enterprise in China's Torch Plan, a demonstration enterprise for China's technological innovation, a Chinese intellectual property advantage enterprise, and a demonstration enterprise for nurturing Chinese industrial brands. The company was awarded the "China Quality Nomination Award" in 2016, and its wire rope products were included in the list of "China Manufacturing Single Item Champion Demonstration Enterprises" in 2017.

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Characteristics of steel wire rope

Construction of steel wire rope

Wire rope is made of several strands and a rope core (metal core, fiber core or other rope core), and the strand is made of several steel rods and a core (central steel wire or fiber core).

Rope core

Rope core is divided into fiber core and steel core fiber core.

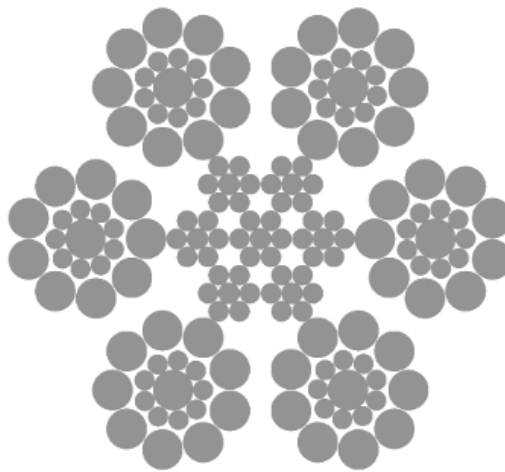
Fiber core steel rope is soft and has good bending performance. When the steel rope is subjected to collision and impact loads during work, the fiber core can play a buffering role. Fiber core is divided into natural fiber core and synthetic fiber core. Natural fiber core has more oil storage, so that the steel rope has enough lubrication internally during work and prevents corrosion of steel wire; synthetic fiber core (such as polypropylene, polyethylene) has good toughness, water absorption, acid resistance, alkali resistance, corrosion resistance, extrusion resistance and wear resistance, etc., and the steel rope is not easy to deform under dynamic load and has a stable diameter.

Steel core

Steel core is divided into independent steel wire core (IWRC) and steel wire core (WSC). Metal and steel core steel rope has large breaking pull force, extrusion resistance and high temperature resistance, and is not easy to deform under dynamic load and has a stable diameter.

linear contact lay wire rope

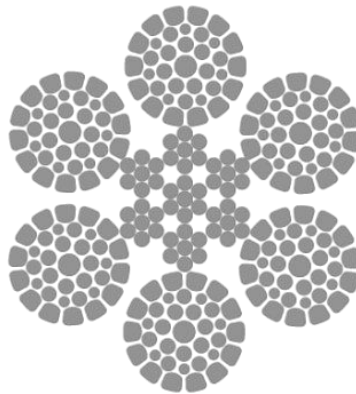
Linear contact lay wire rope the twist length of all steel wires in the rope is the same, and each layer of steel wire is placed on the groove formed between the inner layer of steel wires. The steel wires are in line contact, and the structure of the rope is close. Therefore, the line contact steel wire rope has a large breaking pull force, no secondary bending stress between the layers of steel wires when used, and good fatigue resistance.



6×19S-IWRC

Compacted steel wire rope

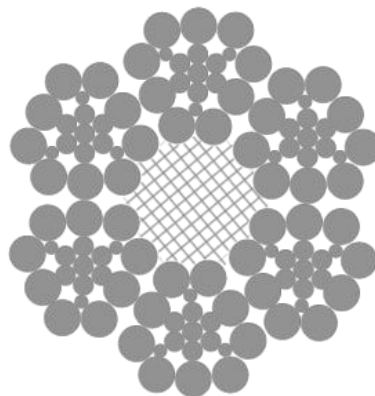
The steel wires in the rope are in surface contact, and the metal filling coefficient of the steel wire rope is large, and the structure of the rope is close. When the steel wire rope is used, the contact stress between the steel wires is small, there is no secondary bending stress, and the contact area between the steel wire rope and the wheel groove is large. Therefore, the compacted steel wire rope has good wear resistance, fatigue resistance and extrusion resistance, and is not easy to deform.



6×K36WS-IWRC

Special-shaped steel wire rope

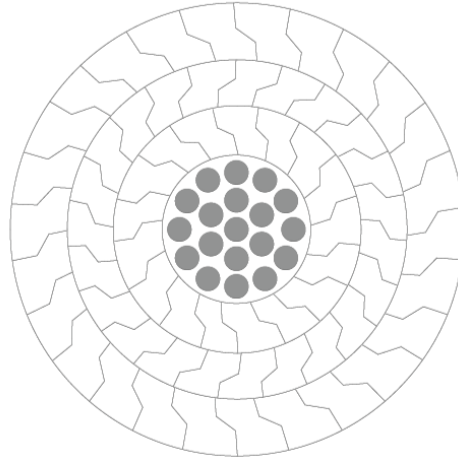
The section of the steel wire rope is not round, which is usually called special-shaped steel wire rope. The main types are triangular and fan-shaped steel wire ropes. The supporting surface of the special-shaped steel wire rope is 3-4 times larger than that of the round steel wire rope, that is, the contact area with the wheel groove is large, the contact stress is small, and the service life is 2-3 times higher than that of the round steel wire rope. The contact points between the rope and the rope of the triangular steel wire rope are increased, and the compression resistance and fatigue resistance are good. The metal effective section area of the special-shaped steel wire rope is large, and the breaking pull force of the whole rope is increased by 25% compared with that of the round steel wire rope at the same diameter and strength.



6×V19-FC

Locked coil wire rope

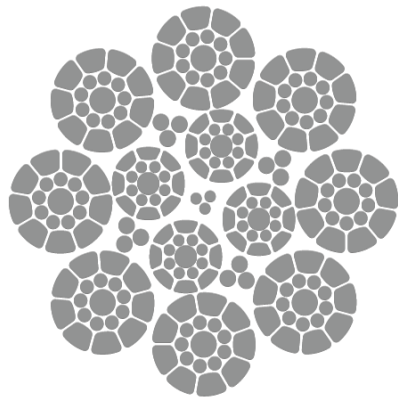
Sealed steel wire rope Sealed steel wire rope layers of special steel wire outside the core are tightly sewn together to form a smooth closed surface, the core and adjacent layers of special steel wire twist to the opposite, so the sealed steel wire rope has the advantages of large metal filling coefficient and breaking pull, good wear resistance, long service life, no rotation, small structural elongation.



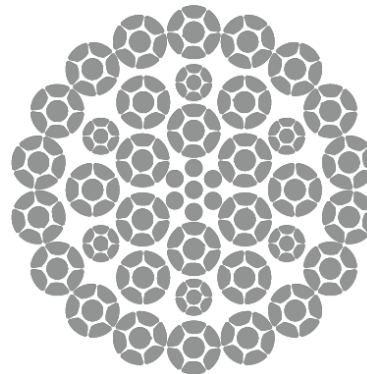
Three layers of Z-wire rope

Resistance rotation steel wire rope

6 or 8 strands of steel wire rope for rotation of steel wire rope, when the steel wire rope is used for single or high lift lifting steel wire rope twist because of rotation, not only affect the service life of the steel wire rope, but also affect the lifting efficiency and safety of operators. By changing the structure and twist method of the steel wire rope can eliminate the rotation of the steel wire rope. The current use of micro-rotation and resistance rotation steel wire rope is multi-strand, three-strand, four-strand round or fan-shaped strand steel wire rope.



8×K19S-PWRC (Slight spin)



35(W)×K7(Stop rotation)

Metal core coated steel wire rope

Plastic polymer coated on the surface of the metal core and between the strands of the steel wire rope, reduce the wear between the strands and the inner and outer layers of the rope, thus improving the wear resistance, fatigue resistance, impact resistance and extrusion resistance of the steel wire rope. Prolong the service life of the steel wire rope.

Galvanized aluminum (zinc) steel wire rope

Galvanized aluminum (zinc) steel wire rope is made of electro galvanized or hot galvanized aluminum (zinc) steel wire twisted. Zinc or zinc aluminum alloy layer in the corrosive environment (such as seawater, marine atmosphere corrosion, hydrogen sulfide, sulfur dioxide atmosphere corrosion, etc.) to protect the steel wire, improve the service life of the wire rope.

Lubrication of steel wire rope

Lubricating oil can prevent steel wire rust, make the lubrication between the steel wire, steel wire rope and pulley components reduce friction. If the user has no special requirements, we in the production of the rope core and the surface of the steel wire rope are coated with lubricating oil, and for important uses and more serious corrosion places with steel wire rope using the stock spray high drop point lubricating oil; friction improvement with steel wire rope coated with grease.

Twisting of steel wire rope

Interactive twist: the twisting direction of the steel wire in the outer layers is opposite to the twisting direction of the outer layers in the steel wire rope. As shown in the figure below.



Right interactive twist (SZ)



Left interactive twist (ZS)

Concurrent twist: the twisting direction of the steel wire in the outer layers is the same as the twisting direction of the outer layers in the steel wire rope. As shown in the figure below.



right-hand lang-lay (ZZ)



left-hand lang-lay (SS)

Number of outer steel wires

For the same diameter of the steel wire rope, the selection of the outer steel wire number of the steel wire rope can improve the wear resistance of the steel wire rope, and the selection of the outer steel wire number of the steel wire rope has the advantages of soft, fatigue resistance.

Approximate calculation of the diameter of the outermost layer of the wire rope

Six-strand steel wire rope: $d = D / (N + 3.5)$

Eight-strand steel wire rope: $d = D / (N + 6.5)$

Where:

d: outer steel wire diameter, in mm.

D: nominal diameter of steel wire rope, in mm.

N: number of outer steel wires of steel wire rope.

Calculation formula for reference weight of steel wire rope

Calculation formula for reference weight of steel wire rope: $M = KD^2$

Where:

M: reference weight of steel wire rope per unit length, in kg/100m.

D: nominal diameter of steel wire rope, in mm.

K: weight coefficient of a certain type of oil-coated steel wire rope per unit length, in kg/100m*mm², the value of K is shown in the table below.

Calculation formula for minimum breaking tension of steel wire rope

Calculation formula for minimum breaking tension of steel wire rope:

$$F = K * D^2 * R / 1000$$

Where:

F--minimum breaking tension of steel wire rope, in KN.

D--nominal diameter of steel wire rope, in mm.

R--nominal tensile strength of steel wire rope, in MPa.

K'--minimum breaking tension coefficient of a certain type of steel wire rope, the value of K' is shown in the table below.

Structural elongation of wire rope

The elongation of wire rope consists of elastic elongation and structural elongation, structural elongation is permanent elongation. Some applications (such as permanent suspension load-bearing structures, reciprocating load-bearing ropes, and other lengths of lifting ropes, etc.) require that the wire rope must be eliminated from the structure of the elongation of the pre-tensioning is to eliminate the effective means of the elongation of the Construction of wire rope. Our company can provide users with this service.

Product Selection

The user should provide the manufacturer with the ordering information given in the appendix when ordering wire rope. The following information should be noted by the user and the manufacturer in selecting and recommending wire ropes.

Relationship between rope strength and sheave hardness

Since the traction drive elevator is driven by the friction between the wire rope and the groove of the traction sheave, friction between the two is inevitable, and the wire rope with a strength level matching the hardness of the groove of the traction sheave should be selected.

Relationship between the material of wire rope core and the groove type of traction sheave

Regardless of whether the V-shaped traction sheave groove has an undercut or not, the radial pressure of the rope groove on the wire rope under load will be greater than that of the U-shaped rope groove, so the V-shaped rope groove of the traction sheave should not be selected for steel-core or composite steel-core wire rope.

The relationship between elevator speed and winding method and the life of wire rope

For elevators with elevator speed $>1.75\text{m/s}$ or 2:1 rope winding method, the influence of elevator speed and rope winding method on the service life of wire rope should be considered when selecting wire rope. It is recommended that the user consults the manufacturer's opinion when selecting the wire rope.

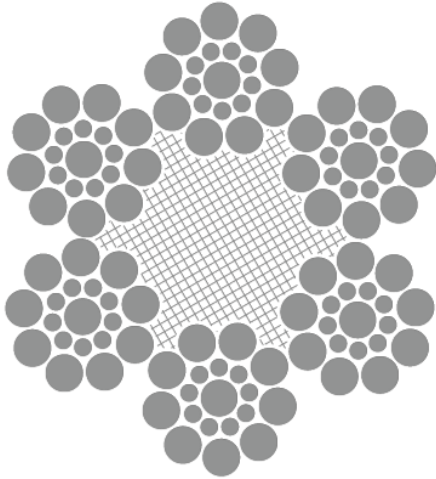
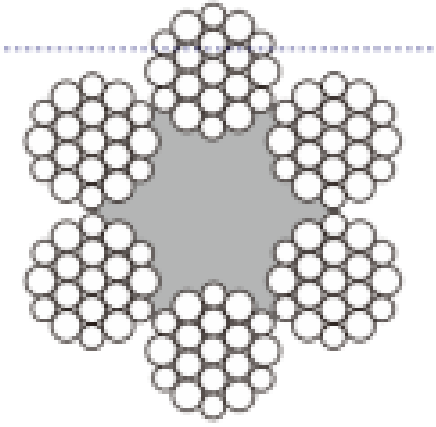
Surface state of wire ropes in corrosive environments

If corrosion is expected or known to be the primary mode of wire rope damage, it is preferable to use wire ropes manufactured from galvanized (or Zn95/Al5 alloy) wire.

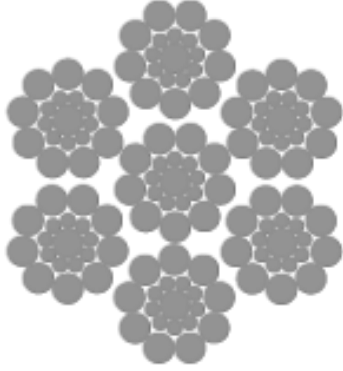
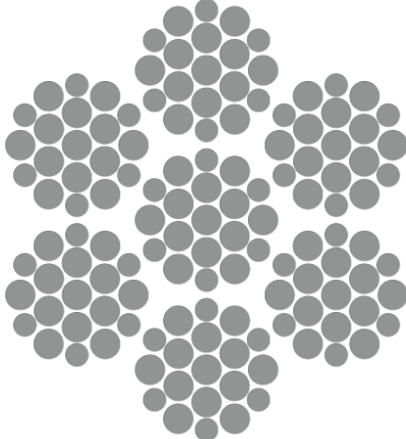
Product Performance

Form	Dissociation MPa	Elastic elongation %	Structural elongation %	Modulus of elasticity kN/2	Durometer	Recommended Use
6×19 fiber core series	1770	≤0.20	≤0.40	75~95	HV=440±20	speed limiter
8×19 fiber core series	1770/1370	≤0.15	≤0.30	60~80	HV=380±20	Elevator traction/speed limiter
	1770/1620			70~90	HV=440±20	Elevator traction rope
8×19 steel core series	1770/1370	≤0.15	≤0.25	60~110	HV=380±20	Elevator traction rope
	1770/1620			80~110	HV=440±20	
8×19 Composite steel core series	1770/1370	≤0.15	≤0.25	70~100	HV=380±20	Elevator traction rope
	1770/1620			70~100	HV=440±20	
9×19 steel core series	1770/1620	≤0.15	≤0.20	80~110	HV=440±20	High-speed elevator traction rope
9×19 Composite steel core series	1770/1620	≤0.15	≤0.20	70~100	HV=440±20	High-speed elevator traction rope

Wire rope for elevator

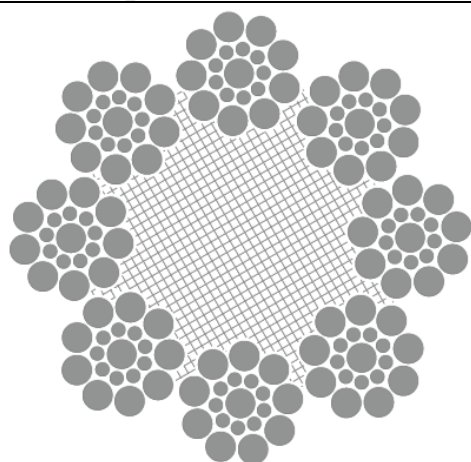
				
6x19S-FC		6x19W-FC		
Nominal diameter of wire rope (mm)	Reference weight (kg/100m)	Minimum breaking tension Kn		
		mono-strength MPa		1960
		1570	1770	
5.0	8.98	13.0	14.6	16.2
5.5	10.9	15.7	17.7	19.6
6	12.9	18.7	21.0	23.3
6.3	14.2	-	23.2	25.7
6.5	15.2	21.9	24.7	27.3
8.2	23.0	33.2	37.4	41.4
9	29.1	42.0	47.3	52.4
9.5	32.4	46.8	52.7	58.4
10	35.9	51.8	58.4	64.7
11	43.4	62.7	70.7	78.3
12	51.7	74.6	84.1	93.1
<p>Note: 1, polypropylene fiber core: modulus of elasticity 1.05×10^5MPa, elastic elongation of about 0.084%.</p> <p>2、Applicable to the most widely used speed limiter wire rope. High breaking tension, low residual elongation, galvanized, quantitative lubrication, polypropylene fiber core.</p>				

Wire rope for elevator

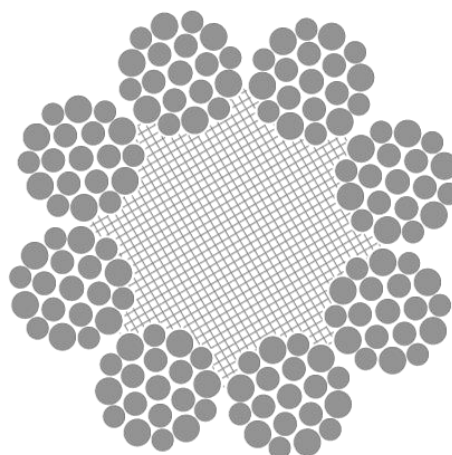
							
		6x19S-WSC			6x19W-WSC		
Nominal diameter of wire rope (mm)	Reference weight (kg/100m)	Minimum breaking tension			kN		
		mono-strength			MPa		
		1570	1770	1960			
5.0	10.1	14.0	15.8	17.4			
5.5	12.3	16.9	19.1	21.1			
6	14.6	20.1	22.7	25.1			
6.3	16.1	22.2	25.0	27.7			
6.5	17.1	23.6	26.6	29.5			
8 ²⁾	25.9	35.8	40.3	44.7			
9	32.8	45.3	51.0	56.5			
9.5	36.6	50.4	56.9	63.0			
10	40.5	55.9	63.0	69.8			

Note: 1. Modulus of elasticity 1.2×10^5 MPa, elastic elongation about 0.067%.
 2. Applicable speed limiter wire rope. Very high breaking tension, very low residual elongation, galvanized, quantitative lubrication, steel core.

Wire rope for elevator



8×19S-FC



8×19W-FC

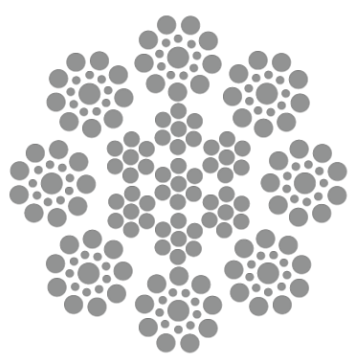
Nominal diameter of wire rope (mm)	Reference weight (kg/100m)	Minimum breaking tension kN						
		double-strength MPa			mono-strength (MPa)			
		1180/ 1770	1320/ 1620	1370/ 1770	1570/ 1770	1570	1620	1770
8	21.8	25.7	26.5	28.1	30.8	29.4	30.4	33.2
9	27.5	32.5	-	35.6	38.9	37.3	-	42.0
9.5	30.7	36.2	37.3	39.7	43.6	41.5	42.8	46.8
10	34.0	40.1	41.3	44.0	48.1	46.0	47.5	51.9
11	41.1	48.6	50.0	53.2	58.1	55.7	57.4	62.8
12	49.0	57.8	59.5	63.3	69.2	66.2	68.4	74.7
12.7	54.8	64.7	66.6	70.9	77.5	74.2	76.6	83.6
13	57.5	67.8	69.8	74.3	81.2	77.7	80.2	87.6
14	66.6	78.7	81.0	86.1	94.2	90.2	93.0	102
14.3	69.5	82.1	-	-	98.3	-	-	-
15	76.5	90.3	-	98.9	108	104	-	117
16	87.0	103	106	113	123	118	122	133
17.5	104	123	-	-	147	-	-	-
18	110	130	134	142	156	149	154	168
19	123	145	149	159	173	166	171	187
20	136	161	165	176	192	184	190	207
20.6	144	170	-	-	204	-	-	-
22	165	194	200	213	233	223	230	251

Note: 1, according to the load, ladder speed, material of rope sheave, groove type, size of rope sheave diameter, etc. to choose the matching Tectonic and strength.

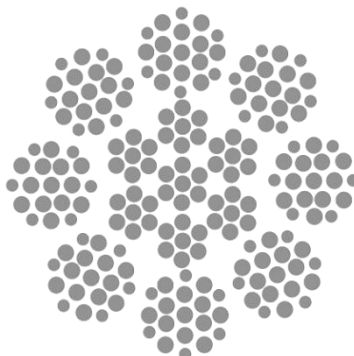
2、Sisal fiber rope core: modulus of elasticity 1.1×10^5 MPa, elastic elongation is about 0.122%.

3、Trailing elevator wire rope with the highest usage rate for medium and low speed elevator. Smooth, lubricated, sisal fiber core.

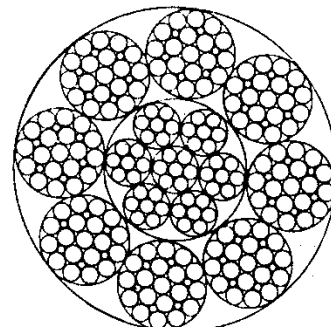
Wire rope for elevator



8×19S-IWR



8×19W-IWR

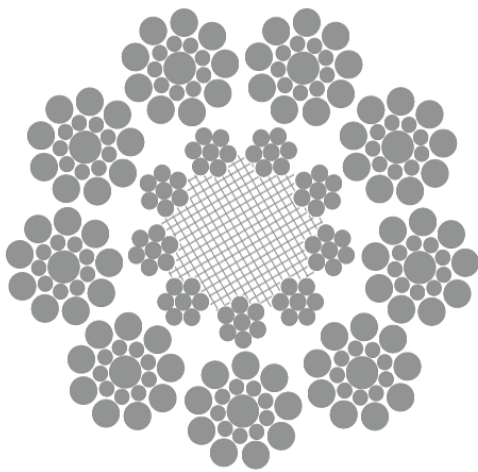
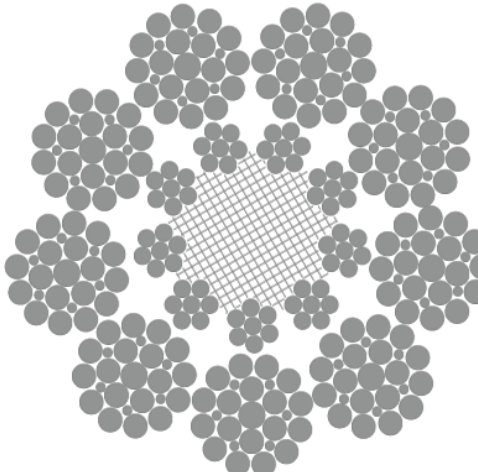


8×25Fi-IWR

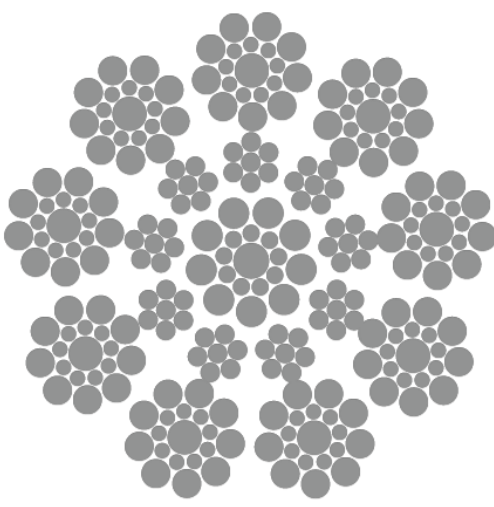
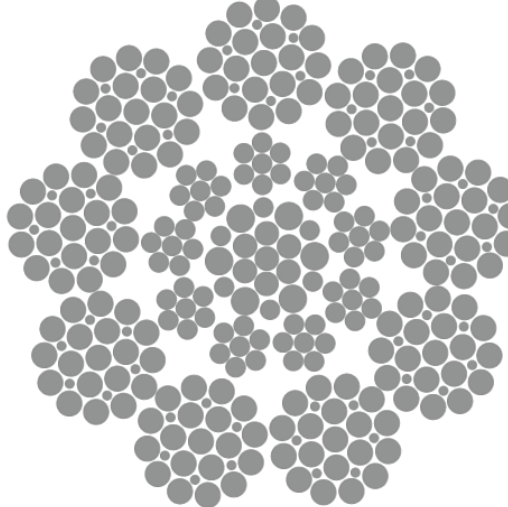
Nominal diameter of wire rope (mm)	Reference weight (kg/100m)	Minimum breaking tension kN				
		double-strength MPa			mono-strength (MPa)	
		1180/1770	1370/1770	1570/1770	1570	1770
8	26.0	33.6	35.8	38.0	35.8	40.3
9	33.0	42.5	45.3	48.2	45.3	51.0
9.5	36.7	47.4	50.4	53.7	50.4	56.9
10	40.7	52.5	55.9	59.5	55.9	63.0
11	49.2	63.5	67.6	79.1	67.6	76.2
12	58.6	75.6	80.5	85.6	80.5	90.7
12.7	65.6	84.7	90.1	95.9	90.1	102
13	68.8	86.7	94.5	100	94.5	106
14	79.8	102	110	117	110	124
15	91.6	118	126	134	126	142
16	104	134	143	152	143	161
18	132	170	181	193	181	204
19	147	190	202	215	202	227
20.6	163	210	224	238	224	252
22	197	254	271	288	271	305

Note: 1, according to the load, ladder speed, material of rope sheave, groove type, size of rope sheave diameter, etc. to choose the matching Tectonic and strength.
 2、 steel core: modulus of elasticity 1.2×10^5 MPa, elastic elongation is about 0.108%.
 3、 Trailing elevator wire rope with the highest usage rate for low and medium-speed elevators, freight elevators and hydraulic elevators. Smooth, lubricated, steel core.

Wire rope for elevator

			
9×19S-9×7-FC		9×25Fi-9×7-FC	
Nominal diameter of wire rope (mm)	Reference weight (kg/100m)	Minimum breaking tension kN	
		Double strength: 1370/1770MPa Single strength 1570MPa	
8	26.9	35.2	
9	34.0	44.5	
10	42.0	55.0	
11	50.8	66.5	
12	60.5	79.1	
13	71.0	92.9	
14	82.3	108	
15	94.5	124	
16	108	141	
18	136	178	
19	152	198	
20	168	220	
22	203	266	
<p>Note: 1, according to the load, ladder speed, material of rope sheave, groove type, size of rope sheave diameter and so on to choose the matching Tectonic and strength.</p> <p>2、 Semi-steel core: modulus of elasticity $1.15 \times 10^5 \text{MPa}$, elastic elongation is about 0.112%.</p> <p>3、 Trailing elevator wire rope with the highest usage rate for medium-speed elevator. Smooth, lubricated, semi-steel core.</p>			

Wire rope for elevator

			
9×19S-9×7-1×19S		9×25Fi-9×7-1×19S	
Nominal diameter of wire rope (mm)	Reference weight (kg/100m)	Minimum breaking tension kN	
		mono-strength	1570MPa
8	29.0	39.5	
9	36.4	50.0	
10	45.0	61.7	
11	54.4	74.7	
12	64.8	88.8	
13	76.0	104	
14	88.2	121	
15	101	139	
16	115	158	
18	146	200	
19	162	223	
20	180	247	
22	218	299	
<p>Note: 1, according to the load, ladder speed, material of rope sheave, groove type, size of rope sheave diameter, etc. to choose the matching Tectonic and strength.</p> <p>2、 steel core: modulus of elasticity $1.15 \times 10^5 \text{MPa}$, elastic elongation is about 0.112%.</p> <p>3、 Trailing elevator wire rope with the highest usage rate for medium and high speed elevator. Smooth, lubricated, steel core.</p>			

Use and maintenance information and end-of-life criteria

Wire rope cutting head bundling method

The wire rope should be inspected regularly according to the requirements of the elevator maintenance specification, including surface cleanliness, grease condition, rope diameter change, the number of broken wires, the distribution of tension between individual wire ropes, and the elongation of the wire rope.

Oiling of wire ropes in use

Under normal circumstances, the wire rope manufacturing process coated with grease, the transportation, storage and use of corrosion damage in the early stage can provide sufficient protection. However, in the process of use, due to wear and dust will make the loss of lubricating grease or formation of grease, increase the steel wire question, between the strands as well as between the wire rope and the traction sheave groove wear and tear, reduce the service life of the wire rope as well as the traction sheave. Therefore, in the process of use, the wire rope (mainly refers to the traction rope) should be timely cleaning, lubrication.

It is recommended that the fiber core wire rope should be operated 200,000 times per run, and the steel core wire rope should be maintained and lubricated once every 100,000 times, which can also be increased or decreased according to the elevator speed, usage environment, and frequency.

Wire rope should be cleaned with brush, cotton yarn or compressed air to clean the surface ash and dirt before oiling, and then oiled with brush oiling, dabbing oiling, portable pressure jet oiling or high pressure jet oiling. Under no circumstances should solvents (such as diesel, kerosene, gasoline, etc.) or cleaning agents be used to clean the wire rope.

General requirements for end-of-life criteria

Typically, elevator ropes are scrapped due to wire breakage and wear. However, other factors such as diameter reduction, corrosion or excessive elongation can also lead to rope failure.

All of these factors should be taken into account when elevator maintenance personnel conduct a thorough inspection of the rope and decide whether to continue to use the rope as a complete set or to scrap it.

Even if only one rope reaches the end-of-life standard, the whole set of ropes should be replaced together, except in special cases where the ropes were damaged during installation or acceptance prior to the delivery of the elevator, in which case the ropes can be replaced individually.

The following clauses are general guidelines for the scrapping of elevator ropes and should be used with reference to the relevant national elevator maintenance codes.

For ropes not running in cast iron or cast steel pulleys, maintenance personnel should be aware that the likelihood of early internal damage to the rope is greater in this case than the likelihood of clearly visible external damage.

wire breakage

Table A.1 gives the fiber core wire rope used in the operation of the elevator replacement or deadline for special inspection and replacement and wire rope scrapping of the visible broken wire number of standards. The values in the table are applicable to wire rope for suspension, wire rope for speed limiter and wire rope for compensation.

For other types of wire rope, should refer to the requirements of the national elevator maintenance specification standards for replacement or scrapping.

Table A.1

Visible wire breaks - fiber-core single strand ropes running in cast iron or cast steel pulleys

prerequisite	Replacement of wire rope or inspection of the wire rope by a qualified professional within a specified period of time.		Immediate scrapping of wire rope	
	6×19-FC series	8×19-FC series	6×19-FC series	8×19-FC series
Broken filaments are randomly distributed in the outer strands	More than 12 in each length of lay ^a	More than 15 in each length of lay ^a	More than 24 in each length of lay ^a	More than 30 in each length of lay ^a
Broken wires concentrated in one or two outer strands	More than 6 in each length of lay ^a	More than 8 in each length of lay ^a	More than 8 in each length of lay ^a	More than 10 in each length of lay ^a
Adjacent broken wires in an outer strand	4	4	More than 4 ^a	More than 4 ^a

^a: A twist length is calculated as 6×d (where d = nominal diameter of the wire rope).

Diameter reduction

If the diameter of the wire rope decreases by 6% relative to the nominal diameter of the wire rope, the wire rope should be replaced.

Abnormal characteristics

If there are obvious abnormal characteristics indicating the possibility of early internal damage to the wire rope, the wire rope should be replaced.

Example 1: Abrasion corrosion: red rust or iron powder oozing out between the strands of the wire rope or between the wire and the wire.

Example 2: Localized reduction in diameter.

Term of Use

There is no clear guideline specification for the service life of suspension ropes, but ropes that have been in use for more than five years should be specially inspected at regular intervals.

Special case

When one of the wire ropes in a set of wire ropes for suspension or compensation is damaged during installation or acceptance before the elevator is delivered for operation, it is permitted to replace the damaged wire rope with a new one, provided that the requirements of the following conditions are met:

a) The technical parameters of the wire rope used for replacement shall be consistent with the technical parameters stated in the product quality certificate of the original complete set of wire rope.

b) The complete set of ropes has not been cut due to elongation from the initial installation.

c) The new replacement wire rope should be installed after the tension check and make the necessary adjustments, the time interval is half a month, continuous inspection period of not less than two months. If six months after the wire rope tension can not be equalized, the whole set of suspension wire rope should be replaced.

d) The replacement wire rope shall be fixed with the same head fixing method as other wire ropes.

e) Under tension, the change in diameter of the replaced wire rope relative to other un-replaced wire ropes shall not exceed 0.5% of the nominal diameter.

When loading and unloading the wire rope disk, it must be loaded and unloaded by crane, so as not to cause damage to the rope disk and the phenomenon of chaotic roll; ground handling, the wire rope disk is not allowed to roll on the uneven ground, so that the surface of the wire rope is crushed; there is no external packaging of the wire rope handling, the surface of the wire rope can not be stuck with stones, clay and so on, which affects the use of the wire rope.

Wire rope should be stored in a dry and ventilated warehouse, to prevent direct sunlight or heat dry baking, the warehouse can not be multi-layer stacking of wire rope. If the wire rope is stored for a long time in large quantities, it should be inspected frequently to prevent rusting, and should be dealt with in time after rusting is found, and lubricated with oil again, such as corrosion is serious, the section of the wire rope should be scrapped, and if it is stored for more than one year, it should be re-tested by taking samples and be qualified for use only after it has been used.

Wire rope has been coated with a certain amount of lubricating oil when manufacturing, but in the process of using grease will diffuse and emit off, so in use should be regularly oiled to the wire rope to ensure that rust and lubrication, to extend the service life of the wire rope.

Precautions for the use of wire rope

Handling, storage and maintenance of wire rope

When loading and unloading the wire rope disk, it must be loaded and unloaded by crane, so as not to cause damage to the rope disk or the phenomenon of chaotic roll; ground handling, the wire rope disk is not allowed to roll on the uneven ground, resulting in the surface of the wire rope pressure injury; no packaging of the wire rope handling, the surface of the wire rope cannot be stuck with stones, clay and so on, affecting the use of the wire rope.

Steel wire rope should be stored in a dry and ventilated warehouse, to prevent direct sunlight or heat dry baking, the warehouse cannot be multi-layer stacking of steel wire rope. If the wire rope is stored in large quantities for a long time, it should be inspected frequently to prevent rusting, and should be treated in time after rusting is found and re-lubricated, such as serious corrosion, the section of wire rope should be scrapped. When the wire rope is placed outdoors, it should be cushioned with wooden boards, placed on dry ground and covered with rain cover. Wire rope storage time more than one year, should be re-sampling test, qualified before use.

Wire rope has been coated with enough lubricating oil when it is manufactured, but in the process of using, the original lubricating oil will be slowly lost and emitted, so the wire rope should be coated with lubricating oil on a regular basis to ensure rust prevention and lubrication, reduce friction and prolong the service life of the wire rope.

Inspection of wire rope

Wire rope in the use of the process, should be in accordance with the relevant provisions of the regular inspection, and will check the results of good records. Inspection content should include the following items: the degree of wear and tear of the wire rope, wire breakage, corrosion, lubrication, deformation, rope connection part or end fastening part and other abnormal phenomena. Wire rope in the reel, pulley and over the wire wheel and other components above the sliding, through the friction components are easy to wear out grooves to make the wire rope wear faster, and sometimes the wear of the pulley will also make the wire rope deformation, increase bending fatigue. Therefore, these components must be carefully inspected, if there is unsuitable, must be immediately replaced or amended.

Wire Rope Unwinding and Reeling Methods

See Fig. 1 for the way of wire rope release and Fig. 2 and Fig. 3 for the way of wire rope reeling.

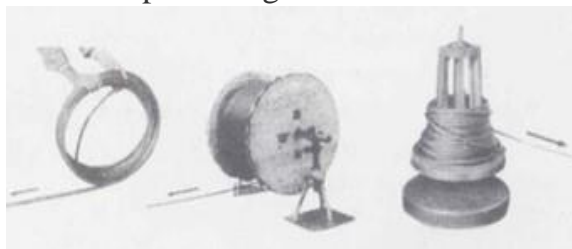


Figure 1: Rope release method

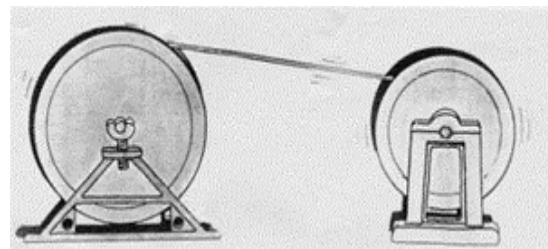


Figure 2: Rope reeling method

When the wire rope is wound in multiple layers of the reel, the tensioning device should be added to the rope release frame to ensure that the wire rope is evenly and tightly wound on the reel, as shown in Figure 3.

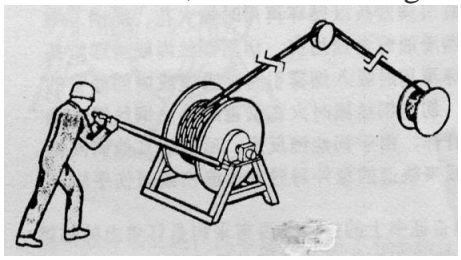


Figure 3

The direction of single-layer winding of wire rope on the reel
 The direction of single layer winding of wire rope on the reel is shown in Fig. 4 and Fig. 5.

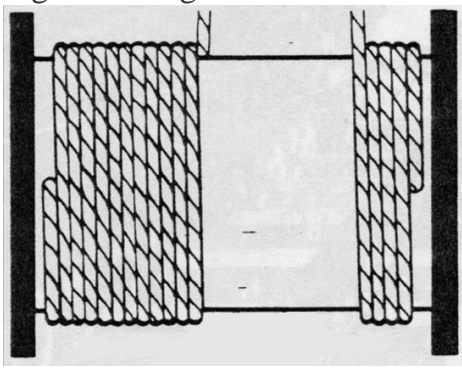


Figure 4: Left twisted wire rope

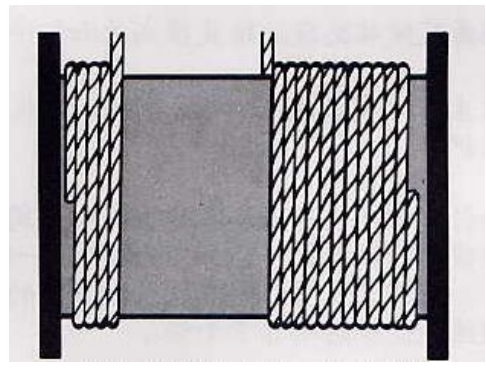


Figure 5: Right twisted wire rope

Wire rope cutting head bundling method

When the wire rope needs to be cut off and used, both ends of the cut head should be tied with wire or small rope strands, and the tying length should be at least 2 times the diameter of the wire rope (D), and the tying length of the parallel twisted wire rope, multi-layer stranded wire rope and single stranded wire rope should be at least 6 times the diameter of the wire rope (D), and the tying method should be as shown in Fig. 6.

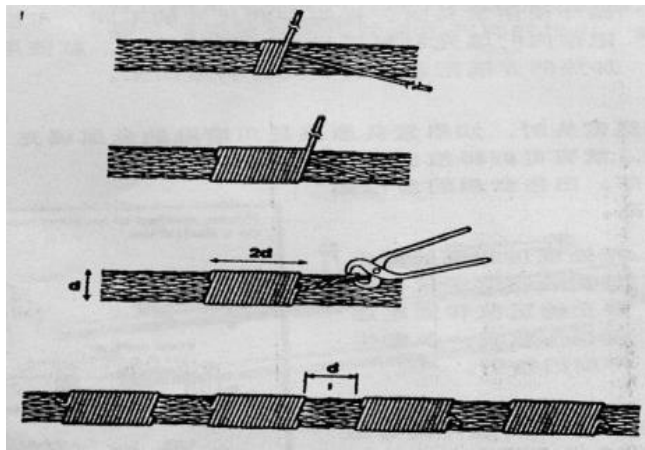


Figure 6

Installation of wire rope

When the old rope is used as the hauling rope of the new rope, the coupling method of welding the new and old rope ends to each other cannot be used, because this method will seriously damage the structure of the new wire rope.

Correct coupling method:

1. As shown in Fig. 7, weld the end of the new wire rope with a ring, pressure head, twisted head processing
2. Use fine steel wire rope or three-strand fiber rope with the same twisting direction as the new wire rope as hauling rope.

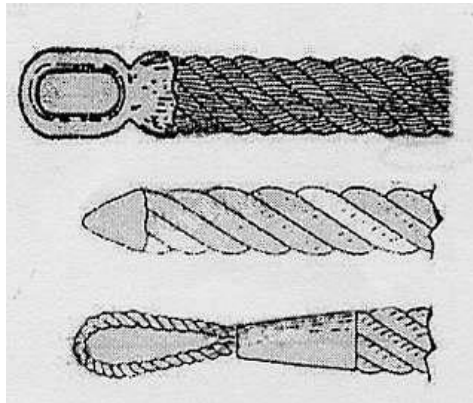


Figure 7

The relationship between wire rope in use and sheave groove

Suitable wheel groove and wire rope contact should be as shown in Figure 8. Wheel groove is too large as shown in Figure 9 and wheel groove is too small as shown in Figure 10, in use will exacerbate the fatigue of the wire rope breakage.

Wheel groove radius (R) and the nominal diameter of the wire rope (D) ratio:
 $R/D=0.525\sim0.550$

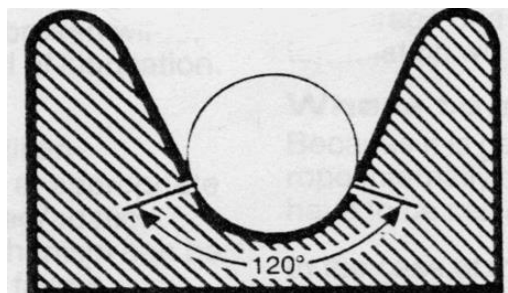


Figure 8 correct

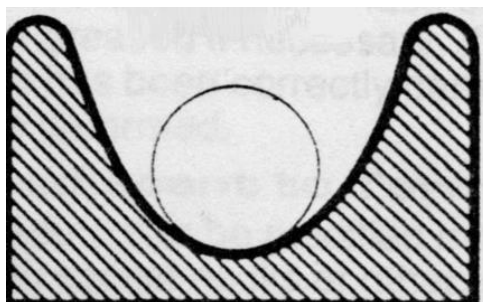


Figure 9 Error

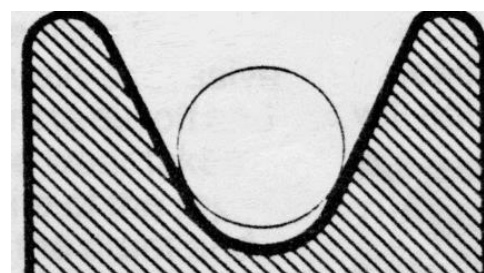


Figure 10 Error

Rope and drum angle

The angle between the wire rope and the drum is shown in Fig. 11, the angle of the ungrooved drum is $<1.5^\circ$, and the angle of the grooved drum is $<2.5^\circ$.

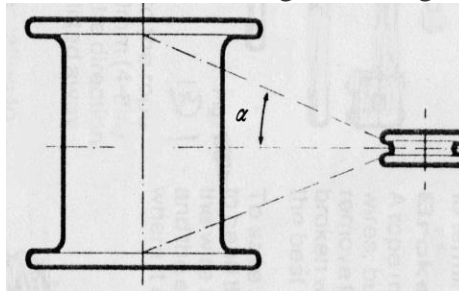


Figure 11

How to use the wire rope clamp

The method of using the wire rope rope clip is shown in Fig. 12.



Figure 12

Wire rope breakage treatment

Wire rope in the process of use, broken wire, wire rope can continue to run, it should be as early as possible to remove the broken wire. Although commonly used method of breaking the broken wire directly clamped off with wire cutters, but is by no means the best method, because it will leave a rough break affecting the use, you can use wire cutters to clamp the broken wire before and after bending until it breaks off, with this method so that the wire breaks in the middle of the strands will not cause harm.

Measurement of wire rope diameter

The diameter of the wire rope is measured as shown in Fig. 14, and Fig. 15 shows the wrong measurement method.

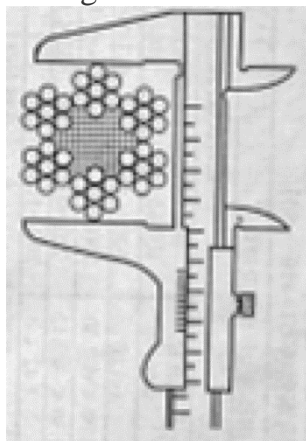


Figure 14

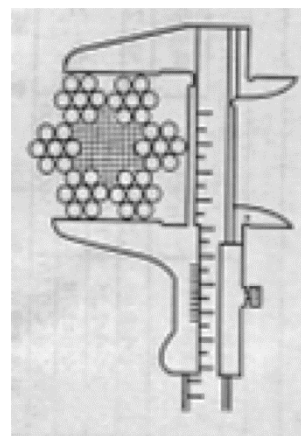


Figure 15

Warning!

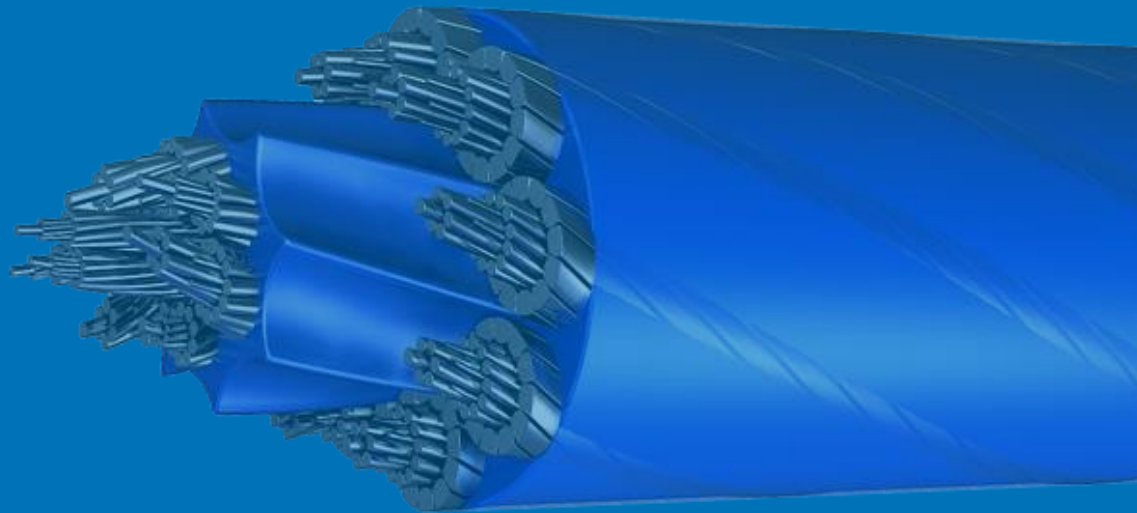
Overweight, wear and tear, misuse, damage and improper maintenance will cause the rope to fail. For your safety and the protection of other equipment.

Attention:



- **Check the wire rope for wear and damage before each use.**
- **Never allow the use of seriously worn, damaged and scrapped wire rope.**
- **Never allow overloading of wire rope.**

Consult the correct method of wire rope use, relevant standards and norms.



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