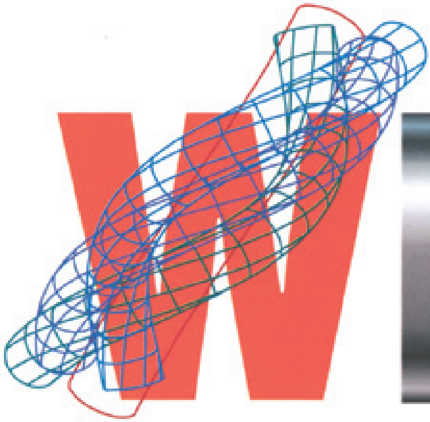


WIRE ROPE

Vol 5

TOKYO ROPE MFG. CO., LTD.

WIRE ROPE

CONTENTS

The Yokohama Bay Bridge is the world's largest dual structure suspension bridge. The cables supporting this bridge are the NEW-PWS of this company.

Realizing a New Dream on Past Achievements.

The Ryuoh Ropeway. The main rope for this gondola, the largest of its kind in the world, with a capacity for 166 people, is this company's 62mm Locked Coil Rope.

Green Dome Maebashi prides itself as Japan's largest steel frame space which uses no columns or pilasters. The roof is held taut with cables [beam string structure].

The wire ropes of this company with their superior characteristics are also indispensable for cranes, including high lift cranes and ship derricks.

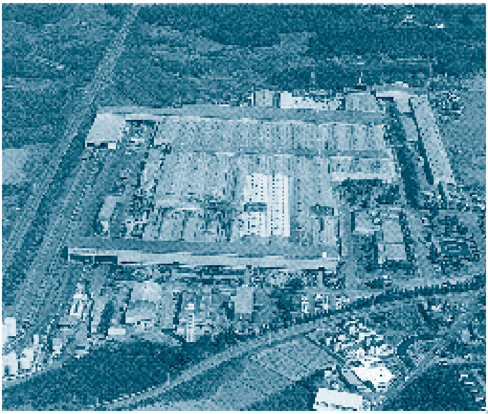
Based

Established in 1887, this company was the first rope maker in the Orient. With a tradition of over one century, we boast unrivalled technologies and facilities. The wire ropes born from this ideal environment are being used widely in all kinds of buildings and structures that are, today, a part of Japan's history, as well as for industrial machines and equipment. As Japan's leading rope maker, this company is turning out highly reliable products to meet the needs of the new age.

The Tokyo Metropolitan Government Office. This 48-story 243 meters high giant building has 83 elevators. The wire ropes of this company are used for all of these elevators.

The Akashikaikyou Bridge (3,911meters). The longest suspension bridge in the world.

Works of This Company



Tsuchiura Works

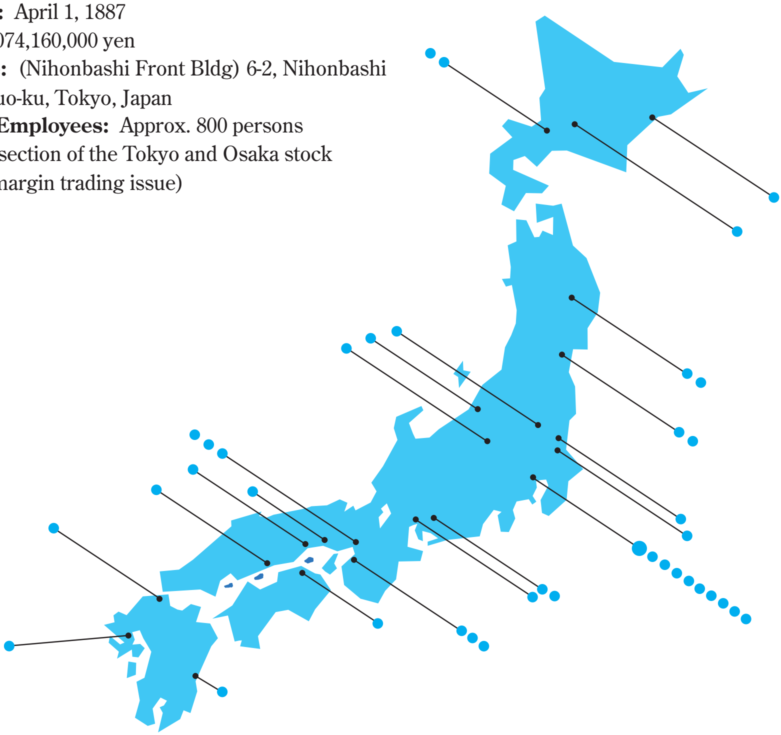
Established: Nov. 1969
Area: 275,000m2
Floor space: 92,000m2
Production capacity
Wire rope : 5,000t/month
Wire: 5,000t/month
ISO 9001 : Registration No. JICQA 3306
ISO 14001 : Registration No. JICQA E1781

Sakai Works

Established: Sep. 2003
Area: 50,000m2
Floor space: 28,000m2
Production capacity
Wire rope : 1,000t/month
Wire: 800t/month
ISO 9001 : Registration No. JICQA 3306
ISO 14001 : Registration No. JICQA E1779

Outline of Company

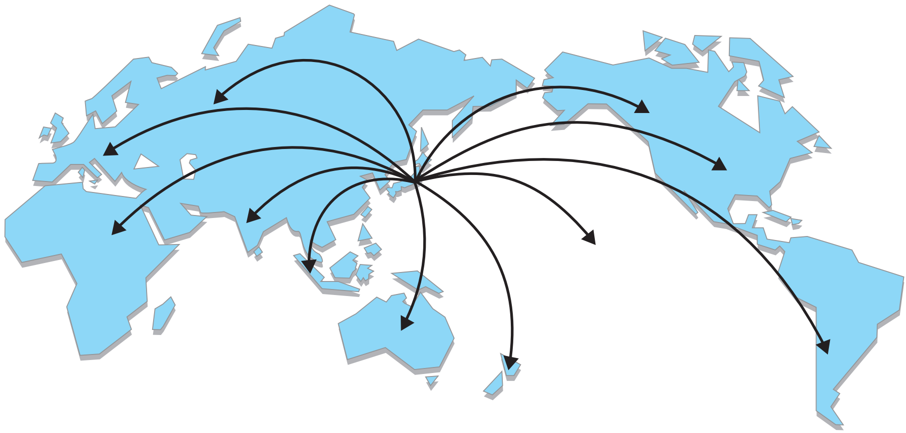
Established: April 1, 1887
Capital: 15,074,160,000 yen
Head Office: (Nihonbashi Front Bldg) 6-2, Nihonbashi 3-chome, Chuo-ku, Tokyo, Japan
Number of Employees: Approx. 800 persons
Shares: 1st section of the Tokyo and Osaka stock exchanges (margin trading issue)



●Tokyo Rope Mfg. Co., Ltd.
Head office: Tokyo
Branch office: Osaka, Sapporo
Works: Tsuchiura, Sakai, Nagoya, Kyushu

●Affiliated Companies of Tokyo Rope
Toko Steel Cord Co., Ltd.
Ako Rope Co., Ltd.
Jiangsu Tokyo Rope Co., Ltd.
Tokyo Seiko Rope Mfg. Co., Ltd.
Toko Machinary Co., Ltd.
Tokyo Bridge Co., Ltd.
Nihon Tokushu Gokin Mfg. Co., Ltd.
Tokyo Seiko Technos. Co., Ltd.
Shinyo Mfg. Co., Ltd.
Tokyo Rope (changzhou) Co., Ltd.
Tokyo Rope (hong kong) Co., Ltd.
Tokyo Rope (Vietname) Co., Ltd.

Principal Countries to Where Exports are Being Made



The products of our company is used throughout the world around the south east Asia such as Taiwan, Hongkong, Singapore including China.

Characteristics of The Company

(1)The latest technologies and facilities

Making full use of its long history and rich experience, this company is constantly developing new and advanced products, based on the latest technology and never-ending research and efforts. As a result, wire ropes with diameters up to 200mm and wires with a diameter of 0.03mm are being turned out, depending on the use.

At the same time, such new products as "sintered products", "metal fibres", and "Aramid fibres rope", "carbon fibre composite Aramid cables", "Zn + 590Al +Na alloy plating (product name: Zincal) among others are being developed one after the other.

Among the facilities are an ultra-large size closing machine, a stranding machine exclusively for locked coils, a high speed plating furnace (zinc, Zincal, brass), pretension devices, a 1,000 ton tension machine, an EPMA, a fluorescent X-ray analyzer, among others. Also, to meet the needs for ropes for ultra-long bridges, this company has the necessary (Bunding) technology and the facilities for turning out parallel wire strands and the NEW-PWS.

(2)Quality

The products of this company are of uniform high quality and are highly evaluated by users, thanks to the strict quality control and the high technical standards maintained within the company.

(3)The manufacture and processing of special products

Based on its rich experience and engineering expertise, the company is turning out products to meet all kinds of needs, both large and small using special equipment and facilities. Large products include locked coil ropes, oval strand ropes, and ultra-large diameter ropes while small, products include steel cords, wire ropes for Aeronautical use.

While manufacturing ultra fine ropes, the company is also manufacturing ultra-strong ropes, high corrosion resistant plating ropes and other special kinds of ropes. The company also leads the industry in developing Toyo-Lok processing and Single-Lok pretension processing. The company is second to none in all aspects and its superior capabilities are highly evaluated by the users.

(4)Research and Development

This company has a history of more than 125 years and based on the technology nurtured during that time has been pushing forward the development of new products and new technologies with importance placed on the needs of the users. At the same time, the company has been actively carrying out research using the latest electronic equipment.

During this period, many products were born, such as steel cords for tires together with the advancement of superhighways, fine ceramics, carbon fibre composite cables and ultra-small diameter metal fibres. This company has been constantly improving the quality of wire ropes, its principal product, for many years and has also been automating the processes. A representative example of this is the various kinds of wire ropes it has been supplying for the bridges connecting Honshu with Shikoku.

■ Main Research Facilities

- ●Field Emission type Scanning Electron Microscope (FE-SEM)
- ●Electron Probe Micro Analyzer (EPMA)
- ●Inductively Coupled Plasma Spectroscope (ICPS)
- ●Rotorflex type X-ray analyzer
- ●Microfluorescent X-ray analyzer
- ●Atomic (absorption) spectrophotometer
- ●Three dimensional surface coarseness and shape measuring instrument
- ●Differential scanning calorimeter
- ●Rapid carbon analyzer
- ●Gas chromatograph
- ●Various kinds of wire fatigue testers
- ●Relaxation tester
- ●Various kinds of rope bend fatigue testers
- ●Rope bending fatigue tester
- ●Rope tensile fatigue tester
- ●Low temperature fatigue tester
- ●Various kinds of steel cord fatigue testers
- ●FALEX wear tester
- ●Salt spray tester
- ●25m High Elevator Fatigue testing fower
- ●Various kinds of experiment devices Annealing, electrocoating, melt coating blueing, wire stretching, lay wire, rope end processing, vacuum annealing, die processing
- ●Rubber vulcanizing press machine

ISO QUALITY SYSTEM …… ISO 9001 JICQA 3306

ISO Enviromental Management System

- Tsuchiura Works …… ISO14001 JICQA E1781
- Sakai Works ………… ISO14001 JICQA E1779

Japanese Industrial Standard (JIS) Designation Approved Items Table

Works	Item	Approval No.	Approval date
Tsuchiura	G 3525 Wire ropes G 3546 Wire ropes with profile wires	QA0307051	January 22, 2008
	G 3536 Uncoated stress-relieved steel wires and strands for prestressed concrete	QA0307054	January 22, 2008
	G 3537 Zinc-coated steel wire strands	QA0307055	January 22, 2008
	G 3521 Hard drawn steel wires	QA0307052	January 22, 2008
	G 3547 Zinc-coated low carbon steel wires	QA0307053	January 22, 2008
Sakai	G 3525 Wire ropes G 3546 Wire ropes with profile wires	QA0307051	January 22, 2008
	G 3537 Zinc-coated steel wire strands	QA0307055	January 22, 2008
	G 3521 Hard drawn steel wires G 3548 Zinc-coated steel wires	QA0307052	January 22, 2008
	G 3547 Zinc-coated low carbon steel wires	QA0307053	January 22, 2008
	G 3549 Wire ropes for structure	QA0312001	June 26, 2012

Approved Items Table Other Than JIS

Division	Organization	Target item	Approval No.	Standard No. type	Approval date
Head Office	Industrial Safety Division Ministry of Labour	TOYO-LOK			February 1957
	LR	TOYO-LOK			July 1969
	Ministry of Construction	Wire ropes with profile wires for Elevator	Tojushihatu No.7		January 1984
	Ministry of Construction	General contractors	58-6119	Scaffold projects Steel structure projects	February 1984
Tsuchiura Works	API	Works (Wire Ropes)	9A-0007	API standard	March 1974
	LR	Works (Wire Ropes)		Lloyd's Rule	March 1973
	DNV	Works (Wire Ropes)		D. N. V. Rule	May 1970
	NK	Zincal Rope	88HW-107SR		
	NTT	High corrosion resistant Steel Wire Strands			May 1989
	Tokyo Electric Power Co.	Galvanized Steel Wire Strand			March 1986
	Kansai Electric Power Co.	Galvanized Steel Wire Strand			July 1987
	JR	Galvanized Steel Wire Strand		JRS57801-1H-14AJ3GA	January 1968
	Building Center	Low relaxation steel wires for PC	BCJ-F199	Low relaxation PCW $7\phi, 9\phi$	November 1980
	NK	Tester			
	LR	Tester			
Sakai Works	LR	Works (Wire Ropes)		Lloyd's Rule	October 1974
	DNV	Works (Wire Ropes)		D. N. V. Rule	June 1975
	Kansai Electric Power Co.	Galvanized Steel Wire Strand			April 1986
	NK	Tester			
	LR	Tester			
	DNV	Tester			

Characteristics

Wire ropes (referred to as ropes herein) have a complicated structure combining many wires. It is important to know the characteristics of the rope when selecting and using.

The characteristics of the rope when compared to general iron and steel secondary products may be given as.

(1) High tensile strength
(2) Superior in impact resistance
(3) Long items can be made (easy to transport)
(4) Rich in flexibility (easy to handle)

On the other hand, depending on the use,
(1)low coefficient of iselasticity
(2)torque arising.

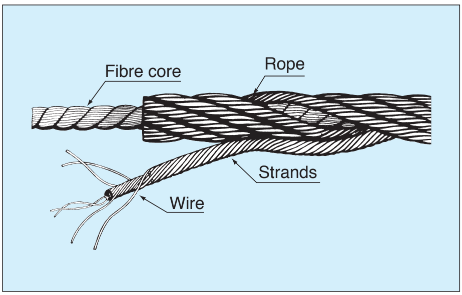
However, countermeasures are being taken, such as pretension processing for (1) above and the use of non-rotating ropes (2) above.

Construction

The construction of the rope differs depending on the number of strands, the number and position of the wires in the strand and whether it is of a fibre core, or rope core. However, an explanation of the construction of a general type rope shall be given here.

As shown in Fig. 1, the rope is made through stranding several to several tens of wires and closing the strands normally six strands around a core in a prescribed pitch.

Fig. 1●Wire rope appearance (example)



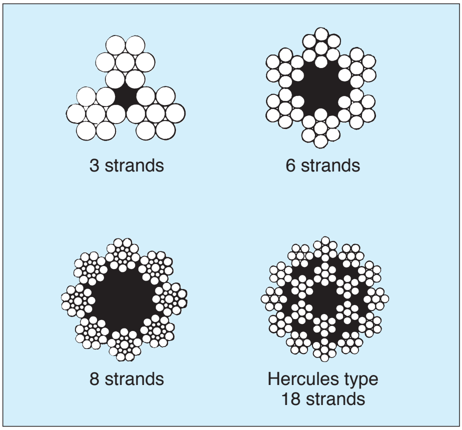
Number of Strands

From three to nine strands are used to make a rope. Apart from some special cases, practically all ropes are made of six strands so as to realize a balanced construction.

However, when used for elevators where special flexibility is required, eight strands are used. Also, when non-torque is required, there are times when two or more layers of strands are used. (See Fig. 2)

For ropes of the same diameter, generally, the more the number of strands the smaller is the diame-ter of each strand. In such cases, the rope may gain flexibility but, on the other hand, the strength will drop and the rope will become inferior in its corrosion resistant nature and shape deformation nature.

Fig. 2●Cross sectional view of wire ropes by number of strands



Laying of The Strands (number of wires and position)

One strand is normally made up of seven to several tens of wires with similar, or differing, diameters in single or multi-layers.

In the method where the wires are positioned to form more than two layers, there is the cross lay where the wires of each layer are in the same lay angle, and the parallel lay where one process is used to lay the wires so that the wires of each layer will be of the same pitch.

For strands of the same diameter, the more the number of wires, the smaller will be the diameter of each wire and the greater will be the flexibility of the strand. However, conversely, the rope will become inferior in its wear resistance nature and its shape deformation nature.

(1)Cross Lay

The cross lay is referred to as the point contact lay, as each wire is in contact with each other. The laying of the wires are carried out in such a way that the lay angle will be almost equal for each layer of wire of the same diameter. The length of the wires in each layer will also be the same and the wires of each layer will be in contact with each other.

Therefore, the tension stress which works on the wire will become uniform, but the bending stress due to the contact points will be added and so the fatigue resistance will not be as great.

Moreover, the 6×7, 6×19 and 6×24 belong to this lay method.

In the positioning of the wires, there is the method where the number of wires around a single core are increased in units of six each, or progressively from 6 to 12 to 18 to 24 and the method where three wires are stranded and made into a core and around this the number of wires increased by six each for each layer, or 9 to 15. Normally, the former positioning is overwhelmingly the most, while the latter is seen only for the 6×24 strand (a+9+15) where the three wire core is replaced with a fibre core.

Fig. 3●6×19 Strand

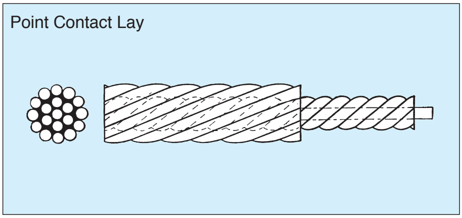
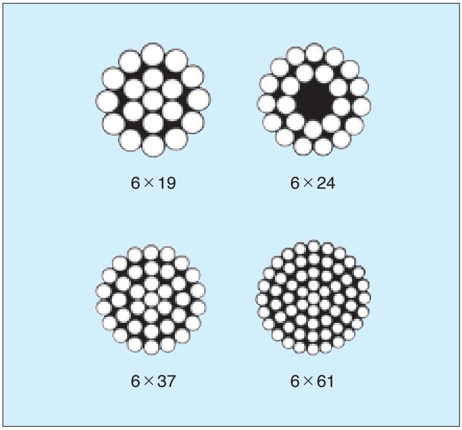


Fig. 4●Cross sectional view example of strand in the cross lay rope



(2)Parallel Lay

Parallel lay is also referred to as equal lay. It is also called one operation lay from the number of stranding processes and also as linear contact lay as each wire is in contact with each other.

Moreover, at this company, the parallel lay rope has the product name of Super Rope.

In the parallel lay, the wires of each layer are positioned in such a way that there will be no space between them and so that the upper layer wires will fit neatly into the groove of the lower wires of the strand.

For this, wires of differing diameters are positioned at the same time so that each wire layer will have the same pitch and will be in contact with each other.

Therefore, differing from the cross lay rope, although the lay angle of each wire layer and the length of the wires are not uniform, as each wire is in contact with each other, it is superior in its fatigue resistance nature.

Moreover, the 6×Fi(25), 6×WS(36) and the 8×S(19) belong to this lay method.

Fig. 5●6×Fi(25) strand

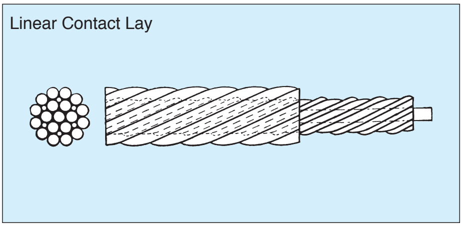
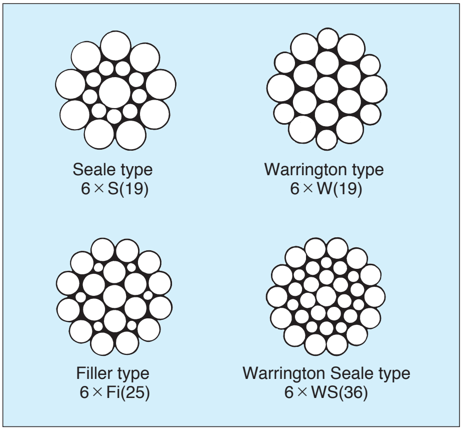


Fig. 6●Cross sectional view example of strand in parallel lay rope



●Basic types

As the basic parallel lay, there are the following four types.

(a)Seale type

The number of wires of each layer is shown as 1+n+n and the number of wires of the inner and outer layers is the same.

The wires of the outer layer fit completely into the grooves of the inner layer wires. The outer layer wires of this Seale type rope is thicker when compared to other parallel lays and so it is superior, particular in its wear resistance and is mainly used for elevators.

(b)Warrington type

The number of wires of each layer is shown as 1 + n + (n + n) and there are two kinds of wires for the outer layers, one being large and the other small. The number of wires of the outer layer is double that of the inner layer and through a combination of the inner and outer layers the spaces between the wires is kept small.

This Warrington type rope is not being used to any great degree, recently.

(c)Filler type (with filler wire)

The number of wires of each layer is shown as 1 + n + (n) + 2n and the number of wires of the outer layers is double that of the inner layer.

The inner wires and the same number of thin filler wires are used to fill the spaces in the inner and outer layers.

This filler type rope has a good balance between the flexibility, fatigue resistance and wear resistance and has the widest range of use among parallel lay ropes.

(d)Warrington Seale type

This is a combination between the Warrington type and the Seale type and is extremely superior in its fatigue resistance nature. It also abounds in flexibility and is superior in its wear resistance nature and so has a wide range of uses.

(3)Flat Type

The strands are combined in such a way that the outer circumference of the rope will be flat in shape. This rope has a smooth surface and so the surface pressure due to coming into contact with the groove of the drum and the sheave is smaller than that of ordinary ropes. It is also superior in its wear resistance nature. In general, the triangular strand and the shell strand are used the most. The flat strand is also being used at certain places.

(a)Triangular strand type

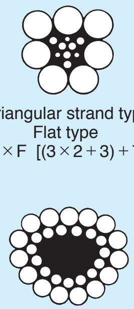
Up to now, an outer layer wire was positioned around the triangular wires but, recently, a single layer or two layers of wires are stranded around a triangular core made of round wires to form a round wire triangular core strand.

(b)Shell strand type

The cross sectional view of this type is in the shape of a shell and this rope is usually in three strands, or four strands.

Also, apart from the fatigue resistance nature, it also has a non-twisting nature. The Mono-Rope of this company which is being widely used belongs to this type.

Fig. 7●Cross sectional view example of strand in a flat type rope



Rope Core

The rope core can be classified into the fibre core and the steel core.

(1)Fibre core (abbreviated as FC)

The fibre core has two important functions, or ① to support the strand and at the same time to hold the shape of the rope, and ② to hold the rope grease and to supply the necessary amount of grease to the inside of the rope, during use, for lubrication and to prevent corrosion. In the past, natural fibre was mainly used but, of late, synthetic fibre is starting to be used.

Two kinds of natural fibres are used, one being the hard fibre, such as Manila and saisal , as well as jute and the other being the soft fibre, such as cotton threads, used in ropes with a comparatively small diameter. Also, for synthetic fibre, specially processed polypropylene is used so that the synthetic fibre will hold the grease well.

The characteristics of fibre core compared to steel core are

(a)The rope has a high flexibility.
(b)Impacts and vibrations to the rope are absorbed.
(c)Holds rope grease well (in particular, in the case of natural fibre)
(d)The unit and mass of the rope is small.

Moreover, synthetics fiber compared to natural fibre is superior in its corrosion resistance nature.

(2)Steel core

For steel cores, there is the strand core (IWSC) and the rope core.

Among the rope cores, there is the IWRC and the CFRC.

(a)The IWSC (independent wire strand core) has the strand as the core and those that have the same construction as the side strand are referred to as the common core.

(b)The IWRC (independent wire rope core) has a single independent rope as the core. Usually, a 7×7 construction is used but depending on the use a 6×7 or a 6×19 may be used.

(c)For the CFRC (center fit wire rope core), the outer layer strand of the core rope is fitted into the groove of the inside of the side strand of the rope.

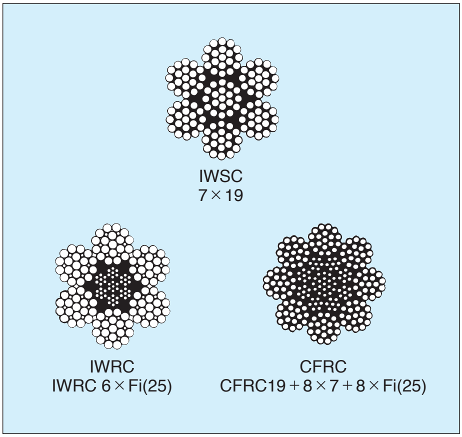
This core rope is positioned in one process with the outer layer rope. Moreover, for the core rope, the 7×7 and the 19+8×7 are used.

The IWSC and the CFRC are used in only a few special cases. Among ropes with a steel core, the IWRC has a good flexibility and so is used the most.

The characteristics of the steel core are as follows compared to the fibre core.

(a)The tope has a high strength.
(b)Resists lateral pressures and does not become deformed easily.
(c)The elongatior of the rope is small and the change of diameter is low.
(d)The rope has a superior heat resistance nature.

Fig. 8●Cross sectional view example of a steel core rope



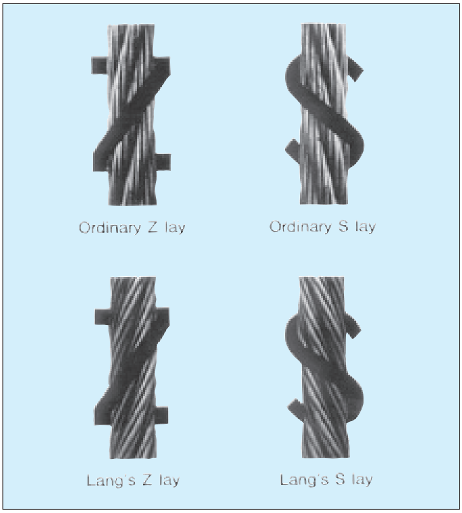
Type of lay

(1)Direction of lay

As concerns the direction of laying the rope and the strand, there is the Z lay and the S lay, as shown in Fig. 9.

In the case otherwise specified, the rope shall be made of the Z lay and the strand products of the S lay.

Fig. 9●Type of lay



(2)Laying of rope

In laying of rope, there is the ordinary lay and the Lang's lay.

(a)Ordinary lay (or regular lay)

The lay of the rope and the lay of the strands are in opposite directions.

(b)Lang's lay

The lay of the rope and the lay of the strands are in the same direction.

(c)Comparison of the characteristics by laying of rope

The differences in the characteristics which inevitably arises from the differences in laying of rope are as shown in Table 1.

Table 1●Comparison of the characteristics by laying of rope

Items	Ordinary lay	Lang's lay
Appearance	The wires are approximately parallel to the axis of the rope.	The wires form a certain angle with the rope axis.
Merits	Kinks do not form easily and is easy to handle The lays are tight and the form does not crumble.	The wires appearing on the surface are long and superior in wear resistance. Flexible and has good fatigue resistance nature.
Demerits	Inferior in wear resistance nature and fatigue resistance nature compared to the Lang's lay.	The rope has a large torque and forms kinks easily.

Preforming

Preforming is a method for lessening the springiness of the rope by giving each strand and wire a form in advance. Ropes made through this method are called preformed, or Tru-lay ropes. The strands and wires do not fall apart even when the rope is cut.

The ropes being manufactured, at present, are practically all preformed ropes. Apart from the 6×61, the non-preformed ropes are only for special uses.

Breaking Force (Grade)

For the breaking force, there is the designated breaking force and the actual breaking force. The designated breaking force is the standard value, or the lowest value of the breaking force, while the actual breaking force is the lowest value at the time the test pieces break.

The breaking force is determined by the nominal tension of the wires making up the rope and is classified as shown in Table 2.

Apart from these, this company will make ropes that exceed the strengths shown, on request.

Kinds of Coating

Ropes are usually of the bright type but when a corrosion resistant nature is required the ropes are coated.

Among the kinds of coating, there is the zinc coating and aluminum coating. Generally however, the zinc coating is used.

Apart from the general hot dip galvanizing, this company is using a high corrosion resistant alloy-coating with zinc and aluminum, under the product name ZINCAL through a high speed coating method.

Both are receiving high evaluation for their supe-rior corrosion resistant nature.

Apart from these, this company can make ropes with a special coating, on request.

Table 2●Grade of Wire ripe

Grade	Remarks
Grade E (1320N/mm^2 {135kgf/mm^2} class)	Bright and galvanized
Grade G (1470N/mm^2 {150kgf/mm^2} class)	Galvanized
Grade A (1620N/mm^2 {165kgf/mm^2} class)	Bright and galvanized
Grade B (1770N/mm^2 {180kgf/mm^2} class)	Bright and galvanized
Grade T (1910N/mm^2 {195kgf/mm^2} class)	Bright

(Note) (1) Wires cold worked after galvanizing shall not exceed 2.80 mm in diameter.
(2) Wires cold worked after galvanizing shall not exceed 2.24 mm in diameter.

Lubricating

Rope grease is applied to the rope at the time of manufacture to prevent corrosion and also to provide lubrication. Great care is taken to apply the rope grease uniformly and so that it will penetrate to the core and strand, through an impregnation method.

The kind of grease applied will greatly influence the life of the rope.

Table 3 below shows the number of bendings before a breaking arose, according to a fatigue test carried out by this company.

Among rope greases, there are the non-crystalline grease such as the Petrolatum and Micro Wax and the red rope grease whose principal ingredient is a special wax made up of micro crystals, as well as the black rope grease whoe principal ingredient is a special kind of bitumen, such as asphalt.

This company has manufactured a special rope grease that is superior in its rust prevention, lubrication, stability and safety.

Table 3●Comparison of the fatigue characteristics of the rope, according to Lubricated or unlubricated

S bend fatigue : 6×Fi(17) O/L 18mmϕ Grade B breaking force 20.7tf) D/d=28 Tension : 2.6tf

Grease condition	Number of repeat bending	
	Up to the first breakage	Up to 10% wire breakage per lay
Lubricated unlubricated	34,500 16,800	48,500 22,500
Lubricated unlubricated	2.05	2.15

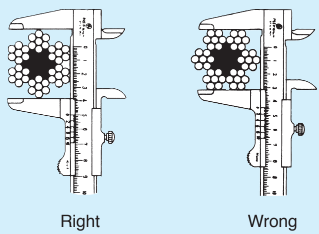
Rope Diameter

Among rope diameters, there is the nominal diameter and the actual diameter (diameter actually measured) and, in principle, for JIS G 3525 (referred to as JIS herein) the standard number (JIS Z8601) is employed. On the other hand, as shown in Fig. 10, the actual diameter is the measurement of the circumscribed circumference and is expressed in mm.

The tolerance on rope diameter shall be $^{+10}_{0}$% for the diameter less than 10mm and $^{+7}_{0}$% for that equal to or more than 10mm, according to JIS.

This company is making ropes with a diameter of up to 200mm, depending on the construction of the rope.

Fig. 10●Measurement of rope diameter



Length

The length of the rope is generally set at 200m, 500m and 1,000m but a longer length can be made on request.

On the other hand, ropes that weight up to 120 tons are being made, depending on the construction of the rope.

Designation and Symbol

The rope is referred to in terms of construction, laying of rope, lay direction of lay, whether naked or galvanized, the kind of rope grease, diameter, grade, breaking force, length and reels. Expressing these in words and numbers would make the designations too lengthy and complex and so this company is using the following symbols.

(1)Construction

Kind of core	Number of strands	×	Lay symbol of the strand	Number of wires per strand
(See Table 4)			(See Table 5)	(See Remarks)

Moreover, in the case there is a product symbol, the symbol is placed at the front (for example, this is T in the case of Tough-Rope).

Table 4●Symbol for the kind of core

Kind of core	Symbol	Remarks
Fibre core	Usually not used	Refer to designation examples 1 and 2
Strand core	Usually not used	In the case the construction of the core strand differs from that of the strand for the rope itself, a symbol is used for expressing this construction (see example 3). In the case the construction is the same, in place of showing IWSC, this is shown as "the number of strands of the rope itself +1" in the "number of strands" column (see example 4)
Rope core	IWRC(Independent Wire Rope Core) or CFRC(Center Fit Wire Rope Core)	In the case the core rope is other than 7×7 the composition is also shown (see example 5) and in the case the core rope is 7×7 the construction of the core rope may be omitted in the parentheses (see example 6).

Table 5●Lay symbol for strand

Lay method	Cross lay		Parallel lay			
Symbol	General	Flat type	Seal type	Warrington type	Filler type	Warrington Seale type
	No symbol	F	S	W	Fi	WS

(Note) The total number of wires per strand is shown but of the flat type rope, apart from the Mono-Rope, the triangular strand rope is disassembled and expressed (see example 7).

●Designation examples

1. 6×7, 6×19, 6×24, 6×37
2. 8×S (19), 6×WS (36)
3. WS (36) + 8×S (19)
4. IWSC 6×37 ⟶ 37 + 6×37 ⟶ 7×37
5. IWRC (6×19)8×WS (36)
6. IWRC (7×7)6×Fi (25) ⟶ IWRC 6×Fi (25)
7. 6×F [(3×2+3) + 12 + 12]

(2)Laying of rope, etc.

The direction of lay and whether galvanized, or not, and the kind rope grease used are abbreviated in Table 6.

Table 6●Abbreviation of laying of rope, etc.

Lay		Ordinary lay				Lang's lay			
		Z lay		S lay		Z lay		S lay	
Kind of rope grease		Red	Black	Red	Black	Red	Black	Red	Black
Bright or Galvanized	Bright	O/O	C/O	O/S	C/S	O/L	C/L	O/LS	C/LS
	Galvanized	G/O	GC/O	G/S	GC/S	G/L	GC/L	G/LS	GC/LS

(Remarks) 1. Laying of rope: The Lang's lay is shown as L and the ordinary lay as O.
2. Direction of lay : In the case of the Z lay, no symbols are used while in the case of S lay, S is used.
3. Bright or galvanized: In the case of naked, no symbols are used, while in the case of galvanized the letter G is used.
4. Kinds of rope grease: Black rope grease is shown as C, while red rope grease is shown as O. However, in the case pf galvanized ropes, the O is omitted. Moreover, in the case of the slip prevention grease, V is used and for fishing industry use the letter T or TN is used.

(3)Grades (breaking force)

grade E, grade G, grade A, grade B grade T or breaking force are expressed in "kN" or "tf ".

(4)Diameter

The rope diameter is expressed in "mm".

(5)Length

The rope length is expressed in "m".

(6)Rope designation examples

(a) 6 strands of 19 wires, fibre core, naked, red rope grease, ordinary lay, Z lay, Grade A, rope diameter 20mm, length 500m, 2 reels, shown as: 6×19 O/O 20mm Grade A 500m×2

(b) 6 strands of 37 wires, fibre core, galvanized, red rope grease, ordinary lay, Z lay, Grade G, rope diameter 16mm, length 200m, 5 reels 6×37 G/O 16mm Grade G 200m×5

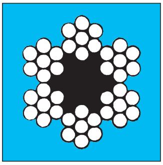
(c) Filler type 6 strands of 29 wires, rope core, galvanized, black rope grease, Lang's lay, S lay, Grade B, rope diameter 30mm, length 1,500m, 1 reel as: IWRC 6×Fi(29) GC/LS 30mm Grade B 1,500m

① Cross Lay Rope

The cross lay rope construction has the longest history and, until the 1930s, when this company was established (and the domestic manufacture of rope was started) and the parallel lay rope, or the socalled seale type was developed, only the cross lay rope was used. With the appearance of the parallel lay rope, the cross lay rope gradually was replaced with the parallel lay rope. However, as the cross lay ropes had some merits which the parallel lay rope did not, such as the ease of handling, it is still continuing to be used, at present.

Main Types and Uses

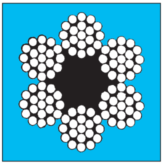
Construction symbol	Main uses
6×7	Lift stay ropes, main rope for ropeways, tugboat use, winch rope for pits and inclined mine shafts, guide rope for digging shafts, trawler use, stay rope (including ship use)
6×19	Forestry industry use rope, winch rope for pits, trawler use stay rope (including ships), boring use, winches and other various kinds of machines.
6×24	Loading and unloading using cranes, etc. Rope Sling fixed shore fishing nets, fisheries industry use such as environment, elevator use, mooring ropes, tow rope, ship use such as cargo ships, winches and other machinery.
6×37 IWRC 6×37	Loading and unloading using cranes, etc., Rope Sling mooring rope, ship use such as cargo ships, lifts, ropeway tension ropes, other kinds of machinery.



6×7 (JIS)
Construction 6×(1+6)

Rope diameter	Outer wire diameter	Sectional area	Breaking force			(Reference) Rough calculation Unit mass
			Ordinary lay	Lang's lay		
			Galvanized	Bright		
			Grade G	Grade A	Grade T	
mm	mm	mm²	kN	kN	kN	kg/m
6	0.67	14.8	**19.0**	**21.4**	24.7	**0.134**
8	0.88	26.3	**33.8**	**38.1**	43.9}	**0.237**
9	1.00	33.3	**42.8**	**48.2**	55.6	**0.300**
10	1.10	41.1	**52.8**	**59.5**	68.6	**0.371**
12	1.33	59.1	**76.0**	**85.6**	98.8	**0.534**
14	1.56	80.5	**103**	**117**	134	**0.727**
16	1.78	105	**135**	**152**	176	**0.950**
18	2.00	133	**171**	**193**	222	**1.20**
20	2.20	164	**211**	**238**	274	**1.48**
22	2.44	199	**256**	**288**	332	**1.80**
24	2.66	237	**304**	**343**	395	**2.14**
26	2.86	278	**357**	**402**	464	**2.51**
28	3.12	322	**414**	**466**	538	**2.91**
30	3.30	370	**475**	**535**	—	**3.34**
32	3.55	420	**541**	**609**	—	**3.80**

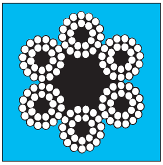
(Remarks) 1. Dash (—) marks represent those that can be made on request.
2. Please refer to Page 46 (Tough Rope) if a higher breaking force is required.
3. The figures shown in bold in this chart denote JIS values.



6×19 (JIS)
Construction 6×(1+6+12)

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay		
			Galvanized	Bright	
			Grade G	Grade A	
mm	mm	mm^2	kN	kN	kg/m
6	0.40	14.1	**18.1**	**19.4**	0.131
8	0.53	25.1	**32.1**	**34.6**	0.233
9	0.60	31.8	**40.7**	**43.8**	0.295
10	0.66	39.3	**50.2**	**54.0**	0.364
12	0.80	56.5	**72.3**	**77.8**	0.524
14	0.93	76.9	**98.4**	**106**	0.713
16	1.06	100	**128**	**138**	0.932
18	1.19	127	**163**	**175**	1.18
20	1.32	157	**201**	**216**	1.46
22	1.45	190	**243**	**261**	1.76
24	1.58	226	**289**	**311**	2.10
26	1.70	265	**339**	**365**	2.46
28	1.86	308	**393**	**424**	2.85

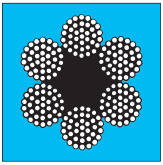
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



6 × 24 (JIS)
Construction 6 × (a + 9 + 15)

Rope diameter (mm)	Outer wire diameter (mm)	Sectional area (mm^2)	Breaking force, Ordinary lay, Galvanized, Grade G (kN)	Breaking force, Ordinary lay, Bright, Grade A (kN)	(Reference) Rough calculation Unit mass (kg/m)
6	0.34	12.5	**16.5**	**17.7**	**0.120**
8	0.44	22.2	**29.3**	**31.6**	**0.212**
9	0.50	28.1	**37.1**	**39.9**	**0.269**
10	0.56	34.8	**45.8**	**49.3**	**0.332**
12	0.67	50.0	**65.9**	**71.0**	**0.478**
14	0.79	68.1	**89.7**	**96.6**	**0.651**
16	0.89	89.0	**117**	**126**	**0.850**
18	1.00	113	**148**	**160**	**1.08**
20	1.10	139	**183**	**197**	**1.33**
22	1.22	168	**222**	**239**	**1.61**
24	1.33	200	**264**	**284**	**1.91**
26	1.43	235	**309**	**333**	**2.24**
28	1.56	272	**359**	**387**	**2.60**
30	1.65	313	**412**	**444**	**2.99**
32	1.78	356	**469**	**505**	**3.40**
36	2.00	450	**593**	**639**	**4.30**
40	2.20	556	**732**	**789**	**5.31**
44	2.44	673	886	954	6.43
48	2.66	801	1050	1140	7.65
50	2.78	869	1140	1230	8.30
53	2.95	976	1290	1380	9.33
56	3.12	1090	1440	1550	10.4
60	3.35	1250	1650	1770	12.0

(Remarks) 1. The figures shown in bold in this chart denote JIS values.



6 × 37 (JIS)
Construction 6 × (1 + 6 + 12 + 18)

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay		
			Galvanized	Bright	
			Grade G	Grade A	
mm	mm	mm²	kN	kN	kg/m
6	0.29	14.1	**17.8**	**19.1**	**0.129**
8	0.38	25.2	**31.6**	**34.0**	**0.230**
9	0.43	31.8	**40.0**	**43.0**	**0.291**
10	0.48	39.3	**49.4**	**53.1**	**0.359**
12	0.57	56.6	**71.1**	**76.5**	**0.517**
14	0.67	77.0	**96.7**	**104**	**0.704**
16	0.76	101	**126**	**136**	**0.920**
18	0.86	127	**160**	**172**	**1.16**
20	0.95	157	**197**	**212**	**1.44**
22	1.05	190	**239**	**257**	**1.74**
24	1.14	226	**284**	**306**	**2.07**
26	1.22	266	**334**	**359**	**2.43**
28	1.33	308	**387**	**416**	**2.82**
30	1.41	354	**444**	**478**	**3.23**
32	1.52	402	**505**	**544**	**3.68**
36	1.70	509	**640**	**688**	**4.66**
40	1.88	629	**790**	**850**	**5.75**
44	2.08	761	**956**	**1030**	**6.96**
48	2.27	905	**1140**	**1220**	**8.28**
52	2.48	1060	**1330**	**1440**	**9.72**
56	2.66	1230	**1550**	**1670**	**11.3**
60	2.86	1410	**1780**	**1910**	**12.9**
67	3.16	1760	2220	2380	16.1
71	3.35	1980	2490	2680	18.1
75	3.55	2210	2780	2990	20.2
80	3.75	2520	3160	3400	23.0
85	4.05	2840	3570	3840	26.0
90	4.28	3180	4000	4300	29.1
95	4.53	3550	4450	4790	32.4
100	4.73	3930	4940	5310	35.9

(Remarks) 1. The figures shown in bold in this chart denote JIS values.

②Parallel Lay Rope (Super-Rope)

After the end of the war, the industries of Japan rapidly became mechanized and more efficient, in all fields, and ropes with an even higher performance than the conventional lay ropes came into demand.

In order to meet this demand, this company started full-scale production of the Super-Rope (the product name for the parallel lay rope of this company) from around 1953. The demand for this rope was greater than expected and Super-Rope was established as the ideal rope for high performance and high efficiency machines and, ever since, its reputation has grown.

At first, of the basic types of Super-Rope, such as the Seale type, Warrington type and Filler type, the Filler type was mainly used.

However, later, as the range of uses widened the semi-Seale type which is a combination between the cross lay and the parallel lay was developed.

And, to meet the demand for even higher performance, the Seale filler type and the Warrington Seale type which are combinations of the basic types were developed.

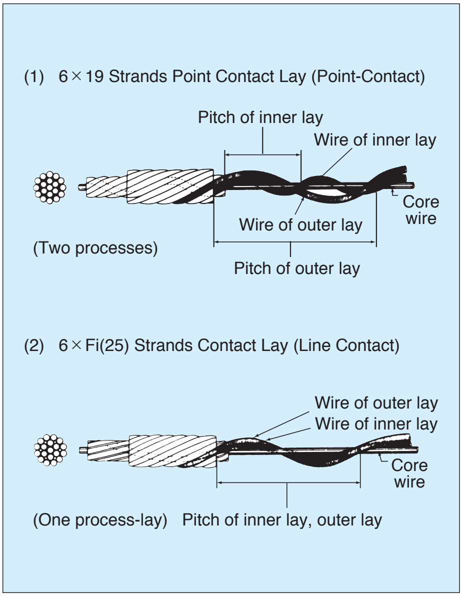
In particular, the balance of each wire diameter composing the strand for the Warrington Seale type is good and, as it is rich in flexibility and fatigue resistance nature, it is being widely used at present.

■ Characteristics

(a)For the conventional cross lay rope, the pitch differed as the wires of each strand were either outer lay or inner lay. Therefore, the wires of each layer were in point contact and in cross lay while, for the Super-Rope, the outer lay and the inner lay have the same pitch and so the wires of each lay are in linear contact.
(See Fig. 1)

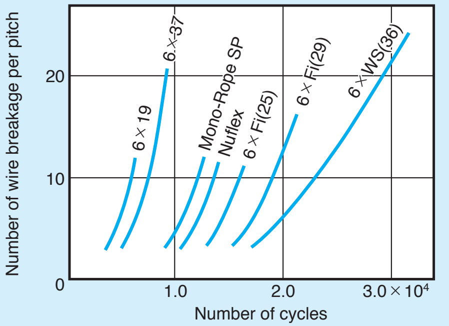
(b)As can be seen in the cross sectional drawing, in Fig. 1(2), as the outer layer wire fits in between the inner lay wires, the strands are tightly bound and the rope is not deformed easily.

Fig. 1●Comparison of the cross lay rope and the Super Rope



(c)As mentioned above, as the wires are in linear contact with each other, fatigue and breakage of the wire due to inner wear and secondary bends, are low and as the pitches are closer together, compared to the cross lay rope, it will display its merits at the condition where there is much bending fatigue. (See Fig. 2)

Fig. 2●Results of the fatigue tests by rope construction



Test conditions: S bending
Rope diameter: 16mm
Sheve diameter: 315mm (D/d=20)
Tension: 19.6kN

(d)As the strand is bound firmly, it does not loose its shape easily even when it receives a strong pressure and the stress is distributed evenly.
(e)The cross section is larger than the cross lay rope and so has a high breaking force.

Selection Standard

There many kinds of ropes and the kinds of machines to which they are attached are almost infinite and so, including the Super-Rope, the best kind of rope to attach to a particular o machine, or equipment, cannot be decided easily. But, compared to the cross lay rope which was used up to now as a rigging, the standard for selecting the Super-Rope is generally as shown in the table below.

Conventional cross lay rope	Representative Super Ropes compared to the cross lay ropes
6×7	6×Fi(17) 6×S(19)
6×19	6×Fi(21) 6×Fi(25) 6×WS(26)
6×24	6×Fi(29) 6×WS(31)
6×37	6×Fi(29) 6×WS(36) 6×WS(41)

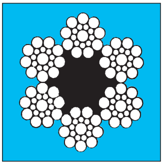
This is only a typical example. The required Super Rope should be selected according to the use.

A rope with a rope core (IWRC) should be selected if the rope is to be used in a very hot environment, if it is wound randomly on a small diameter drum, or if the rope is subject to strong sidewise pressure, or when a non-stretching rope is required.

This company is also making the Long Super-Rope which has a smaller torque nature than general ropes for cranes with a comparatively large lifting range.

Main Types and Uses

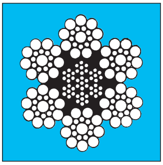
Construction symbol	Main uses
6×S(19)	Ropeways, inclined shaft winches, fisheries industry use
IWRC 6×S(19)	Fencing use, bulldozer use
6×Fi(25)	Ropeways, inclined shaft winches, general crane use, forestry industry use
IWRC 6×Fi(25)	Fencing use, heavy machinery use
6×Fi(29)	Ropeways, general crane use
IWRC 6×Fi(29)	General crane use, heavy equipment use
6×WS(26)	General crane use, fisheries industry trawler use (trawl warp)
IWRC 6×WS(26)	General crane use, bulldozer use
6×WS(31)	General crane use, fisheries industry trawler use (trawl rope)
IWRC 6×WS(31)	General crane use, heavy equipment use, bulldozer use
6×WS(36)	Ropeway stay rope use, general crane use
IWRC 6×WS(36)	General crane use, ship use
6×WS(41)	General crane use
IWRC 6×WS(41)	General crane use



6 × S (19) (JIS)
Construction 6 × S (1 + 9 + 9)

Rope diameter	Outer wire diameter	Sectional area	Breaking force			(Reference) Rough calculation Unit mass
			Ordinary lay・Lang's lay			
			Bright・Galvanized		Bright	
			Grade A	Grade B	Grade T	
mm	mm	mm^2	kN	kN	kN	kg/m
6	0.50	15.1	**19.6**	**20.9**	**22.0**	**0.139**
6.3	0.52	16.6	**21.6**	**23.0**	**24.2**	**0.153**
8	0.65	26.8	**34.9**	**37.2**	**39.1**	**0.247**
9	0.74	33.9	**44.1**	**47.0**	**49.5**	**0.312**
10	0.82	41.9	**54.5**	**58.1**	**61.1**	**0.386**
11.2	0.92	52.6	**68.3**	**72.8**	**76.6**	**0.484**
12	0.99	60.4	**78.4**	**83.6**	**88.0**	**0.556**
12.5	1.03	65.5	**85.1**	**90.7**	**95.4**	**0.603**
14	1.15	82.1	**107**	**114**	**120**	**0.756**
16	1.32	107	**139**	**149**	**156**	**0.988**
18	1.47	136	**176**	**188**	**198**	**1.25**
20	1.63	168	**218**	**232**	**244**	**1.54**
22.4	1.83	210	**273**	**291**	**306**	**1.94**
25	2.06	262	**340**	**363**	**382**	**2.41**
28	2.30	329	427	**455**	**479**	**3.02**
30	2.44	377	490	**523**	**550**	**3.47**
31.5	2.58	416	540	**576**	**606**	**3.83**
33.5	2.74	470	611	**652**	**685**	**4.33**
35.5	2.90	528	686	**732**	**770**	**4.86**
37.5	3.07	589	766	**816**	**859**	**5.43**
40	3.25	671	871	**929**	**977**	**6.17**

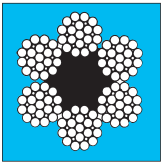
(Remarks) 1. Dash (—) marks represent those that can be made on request.
2. The figures shown in bold in this chart denote JIS values.



IWRC 6 × S (19) (JIS)
Construction 7 × 7 + 6 × S (1 + 9 + 9)

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay・Lang's lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm²	kN	kN	kg/m
8	0.65	31.6	42.4	44.5	0.275
9	0.74	40.0	53.6	56.3	0.348
10	0.82	49.4	**66.2**	**69.5**	**0.430**
11.2	0.92	61.9	**83.0**	**87.2**	**0.539**
12.5	1.03	77.1	**103**	**109**	**0.672**
14	1.15	96.7	**130**	**136**	**0.843**
16	1.32	126	**169**	**178**	**1.10**
18	1.47	160	**214**	**225**	**1.39**
20	1.63	197	**265**	**278**	**1.72**
22.4	1.83	248	**332**	**349**	**2.16**
25	2.06	309	**414**	**435**	**2.69**
28	2.30	387	**519**	**545**	**3.37**
30	2.44	444	**596**	**626**	**3.87**
31.5	2.58	490	**657**	**690**	**4.27**
33.5	2.74	554	**743**	**780**	**4.83**
35.5	2.90	622	**834**	**876**	**5.42**
37.5	3.07	694	**931**	**978**	**6.05**
40	3.25	790	**1060**	**1110**	**6.88**

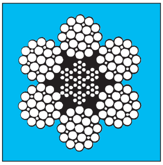
(Remarks) 1. Dash (—) marks represent those that can be made on request.
2. The figures shown in bold in this chart denote JIS values.



6 × Fi (25) (JIS)
Construction 6 × Fi [1 + 6 + (6) + 12]

Rope diameter	Outer wire diameter	Sectional area	Breaking force			(Reference) Rough calculation Unit mass
			Ordinary lay・Lang's lay			
			Bright・Galvanized		Bright	
			Grade A	Grade B	Grade T	
mm	mm	mm²	kN	kN	kN	kg/m
6	0.39	15.1	**19.6**	20.9	22.0	**0.139**
6.3	0.41	16.6	**21.6**	23.0	24.2	**0.153**
8	0.52	26.8	**34.9**	**37.2**	**39.1**	**0.247**
9	0.59	33.9	**44.1**	**47.0**	**49.5**	**0.312**
10	0.65	41.9	**54.5**	**58.1**	**61.1**	**0.386**
11.2	0.73	52.6	**68.3**	**72.8**	**76.6**	**0.484**
12	0.79	60.4	**78.4**	**83.6**	**88.0**	**0.556**
12.5	0.82	65.5	**85.1**	**90.7**	**95.4**	**0.603**
14	0.92	82.1	**107**	**114**	**120**	**0.756**
16	1.05	107	**139**	**149**	**156**	**0.988**
18	1.17	136	**176**	**188**	**198**	**1.25**
20	1.30	168	**218**	**232**	**244**	**1.54**
22.4	1.45	210	**273**	**291**	**306**	**1.94**
25	1.63	262	**340**	**363**	**382**	**2.41**
28	1.83	329	427	**455**	**479**	**3.02**
30	1.94	377	490	**523**	**550**	**3.47**
31.5	2.06	416	540	**576**	**606**	**3.83**
33.5	2.17	470	611	**652**	**685**	**4.33**
35.5	2.30	528	686	**732**	**770**	**4.86**
37.5	2.44	589	766	**816**	**859**	**5.43**
40	2.58	671	871	**929**	**977**	**6.17**

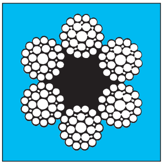
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



IWRC 6×Fi (25) (JIS)
Construction 7×7+6×Fi [1+6+(6)+12]

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay・Lang's lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm^2	kN	kN	kg/m
8	0.52	31.6	42.4	44.5	0.275
9	0.59	40.0	53.6	56.3	0.348
10	0.65	49.4	**66.2**	**69.5**	**0.430**
11.2	0.73	61.9	**83.0**	**87.2**	**0.539**
12.5	0.82	77.1	**103**	**109**	**0.672**
14	0.92	96.7	**130**	**136**	**0.843**
16	1.05	126	**169**	**178**	**1.10**
18	1.17	160	**214**	**225**	**1.39**
20	1.30	197	**265**	**278**	**1.72**
22.4	1.45	248	**332}**	**349**	**2.16**
25	1.63	309	**414**	**435**	**2.69**
28	1.83	387	**519**	**545**	**3.37**
30	1.94	444	**596**	**626**	**3.87**
31.5	2.06	490	**657**	**690**	**4.27**
33.5	2.17	554	**743**	**780**	**4.83**
35.5	2.30	622	**834**	**876**	**5.42**
37.5	2.44	694	**931**	**978**	**6.05**
40	2.58	790	**1060**	**1110**	**6.88**

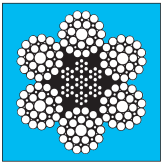
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



6 × Fi (29) (JIS)
Construction 6 × Fi [1 + 7 + (7) + 14]

Rope diameter mm	Outer wire diameter mm	Sectional area mm²	Breaking force, Ordinary lay · Lang's lay, Bright · Galvanized, Grade B kN	Breaking force, Ordinary lay · Lang's lay, Bright, Grade T kN	(Reference) Rough calculation Unit mass kg/m
8	0.46	27.2	37.9	39.9	0.253
9	0.52	34.5	48.0	50.4	0.321
10	0.57	42.6	59.2	62.3	0.396
11.2	0.64	53.4	74.3	78.1	0.496
12.5	0.72	66.5	92.5	97.3	0.618
14	0.81	83.4	116	122	0.776
16	0.92	109	152	159	1.01
18	1.03	138	192	202	1.28
20	1.14	170	237	249	1.58
22.4	1.28	213	297	312	1.99
25	1.43	266	370	389	2.47
28	1.60	334	464	488	3.10
30	1.70	383	533	560	3.56
31.5	1.80	422	588	618	3.93
33.5	1.91	478	665	699	4.44
35.5	2.03	536	746	785	4.99
37.5	2.14	598	833	876	5.57
40	2.27	681	948	996	6.33
42.5	2.40	769	1070	1120	7.15
45	2.58	862	1200	1260	8.01
47.5	2.70	960	1340	1400	8.93
50	2.86	1060	1480	1560	9.90
53	3.03	1200	1660	1750	11.1
56	3.20	1330	1860	1950	12.4
60	3.45	1530	2130	2240	14.2

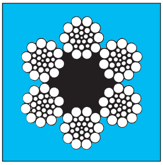
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



IWRC 6 × Fi (29) (JIS)
Construction 7 × 7 + 6 × Fi [1 + 7 + (7) + 14]

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay・Lang's lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm²	kN	kN	kg/m
8	0.46	32.0	43.3	45.5	0.282
9	0.52	40.5	54.8	57.6	0.356
10	0.57	50.0	**67.7**	**71.1**	**0.440**
11.2	0.64	62.7	**84.9**	**89.2**	**0.552**
12.5	0.72	78.1	**106**	**111**	**0.688**
14	0.81	98.0	**133**	**139**	**0.863**
16	0.92	128	**173**	**182**	**1.13**
18	1.03	162	**219**	**230**	**1.43**
20	1.14	200	**271**	**284**	**1.76**
22.4	1.28	251	**340**	**357**	**2.21**
25	1.43	312	**423**	**444**	**2.75**
28	1.60	392	**531**	**558**	**3.45**
30	1.70	450	**609**	**640**	**3.96**
31.5	1.80	496	**672**	**706**	**4.37**
33.5	1.91	561	**760**	**798**	**4.94**
35.5	2.03	630	**853**	**896**	**5.55**
37.5	2.14	703	**952**	**1000**	**6.19**
40	2.27	800	**1080**	**1140**	**7.04**
42.5	2.40	903	**1220**	**1280**	**7.95**
45	2.58	1010	**1370**	**1440**	**8.91**
47.5	2.70	1130	**1530**	**1600**	**9.93**
50	2.86	1250	**1690**	**1780**	**11.0**
53	3.03	1400	**1900**	**2000**	**12.4**
56	3.20	1570	**2120**	**2230**	**13.8**
60	3.45	1800	**2440**	**2560**	**15.8**

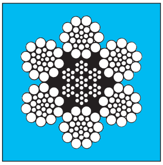
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



6 × **WS (26)** (JIS)
Construction 6 × WS [1 + 5 + (5 + 5) + 10]

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay・Lang's lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm^2	kN	kN	kg/m
8	0.60	26.8	37.2	39.1	0.247
9	0.68	33.9	47.0	49.5	0.312
10	0.75	41.9	58.1	61.1	0.386
11.2	0.84	52.6	72.8	76.6	0.484
12	0.90	60.4	83.6	88.0	0.556
12.5	0.95	65.5	90.7	95.4	0.603
14	1.06	82.1	114	120	0.756
16	1.20	107	149	156	0.988
18	1.35	136	188	198	1.25
20	1.50	168	232	244	1.54
22.4	1.68	210	291	306	1.94
25	1.88	262	363	382	2.41
28	2.11	329	455	479	3.02
30	2.24	377	523	550	3.47
31.5	2.37	416	576	606	3.83
33.5	2.51	470	652	685	4.33
35.5	2.66	528	732	770	4.86
37.5	2.82	589	816	859	5.43
40	3.00	671	929	977	6.17

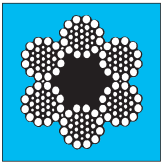
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



IWRC 6 × WS (26) (JIS)
Construction 7 × 7 + 6 × WS [1 + 5 + (5 + 5) + 10]

Rope diameter mm	Outer wire diameter mm	Sectional area mm^2	Breaking force Ordinary lay・Lang's lay Bright・Galvanized Grade B kN	Breaking force Ordinary lay・Lang's lay Bright Grade T kN	(Reference) Rough calculation Unit mass kg/m
8	0.60	31.6	42.4	44.5	0.275
9	0.68	40.0	53.6	56.3	0.348
10	0.75	49.4	**66.2**	**69.5**	**0.430**
11.2	0.84	61.9	**83.0**	**87.2**	**0.539**
12.5	0.95	77.1	**103**	**109**	**0.672**
14	1.06	96.7	**130**	**136**	**0.843**
16	1.20	126	**169**	**178**	**1.10**
18	1.35	160	**214**	**225**	**1.39**
20	1.50	197	**265**	**278**	**1.72**
22.4	1.68	248	**332**	**349**	**2.16**
25	1.88	309	**414**	**435**	**2.69**
28	2.11	387	**519**	**545**	**3.37**
30	2.24	444	**596**	**626**	**3.87**
31.5	2.37	490	**657**	**690**	**4.27**
33.5	2.51	554	**743**	**780**	**4.83**
35.5	2.66	622	**834**	**876**	**5.42**
37.5	2.82	694	**931**	**978**	**6.05**
40	3.00	790	**1060**	**1110**	**6.88**

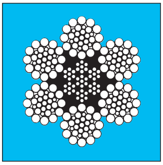
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



6 × **WS (31)** (JIS)
Construction 6 × WS [1 + 6 + (6 + 6) + 12]

Rope diameter	Outer wire diameter	Sectional area	Breaking force, Ordinary lay・Lang's lay, Bright・Galvanized, Grade B	Breaking force, Ordinary lay・Lang's lay, Bright, Grade T	(Reference) Rough calculation Unit mass
mm	mm	mm^2	kN	kN	kg/m
16	1.05	111	152	159	1.01
18	1.17	140	192	202	1.28
20	1.30	173	**237**	**249**	**1.58**
22.4	1.45	217	**297**	**312**	**1.99**
25	1.63	270	**370**	**389**	**2.47**
28	1.83	339	**464**	**488**	**3.10**
30	1.94	389	**533**	**560**	**3.56**
31.5	2.06	428	**588**	**618**	**3.93**
33.5	2.17	485	**665**	**699**	**4.44**
35.5	2.30	544	**746**	**785**	**4.99**
37.5	2.44	607	**833**	**876**	**5.57**
40	2.58	691	**948**	**996**	**6.33**
42.5	2.74	780	**1070**	**1120**	**7.15**
45	2.95	874	**1200**	**1260**	**8.01**
47.5	3.07	974	**1340**	**1400**	**8.93**
50	3.25	1080	**1480**	**1560**	**9.90**
53	3.45	1210	**1660**	**1750**	**11.1**
56	3.65	1350	**1860**	**1950**	**12.4**
60	3.93	1550	**2130**	**2240**	**14.2**

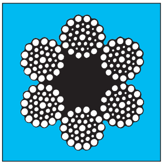
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



IWRC 6 × WS (31) (JIS)
Construction 7 × 7 + 6 × WS [1 + 6 + (6 + 6) + 12]

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay・Lang's lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm²	kN	kN	kg/m
16	1.05	130	173	182	1.13
18	1.17	164	219	230	1.43
20	1.30	202	**271**	**284**	**1.76**
22.4	1.45	254	**340**	**357**	**2.21**
25	1.63	316	**423**	**444**	**2.75**
28	1.83	397	**531**	**558**	**3.45**
30	1.94	456	**609**	**640**	**3.96**
31.5	2.06	502	**672**	**706**	**4.37**
33.5	2.17	568	**760**	**798**	**4.94**
35.5	2.30	638	**853**	**896**	**5.55**
37.5	2.44	712	**952**	**1000**	**6.19**
40	2.58	810	**1080**	**1140**	**7.04**
42.5	2.74	914	**1220**	**1280**	**7.95**
45	2.95	1030	**1370**	**1440**	**8.91**
47.5	3.07	1140	**1530**	**1600**	**9.93**
50	3.25	1270	**1690**	**1780**	**11.0**
53	3.45	1420	**1900**	**2000**	**12.4**
56	3.65	1590	**2120**	**2230**	**13.8**
60	3.93	1820	**2440**	**2560**	**15.8**

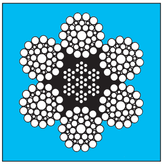
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



6 × **WS (36)** (JIS)
Construction 6 × WS [1 + 7 + (7 + 7) + 14]

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay・Lang's lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm²	kN	kN	kg/m
16	0.92	111	152	159	1.01
18	1.03	140	192	202	1.28
20	1.14	173	**237**	**249**	**1.58**
22.4	1.28	217	**297**	**312**	**1.99**
25	1.43	270	**370**	**389**	**2.47**
28	1.60	339	**464**	**488**	**3.10**
30	1.70	389	**533**	**560**	**3.56**
31.5	1.80	428	**588**	**618**	**3.93**
33.5	1.91	485	**665**	**699**	**4.44**
35.5	2.03	544	**746**	**785**	**4.99**
37.5	2.14	607	**833**	**876**	**5.57**
40	2.27	691	**948**	**996**	**6.33**
42.5	2.40	780	**1070**	**1120**	**7.15**
45	2.58	874	**1200**	**1260**	**8.01**
47.5	2.70	974	**1340**	**1400**	**8.93**
50	2.86	1080	**1480**	**1560**	**9.90**
53	3.03	1210	**1660**	**1750**	**11.1**
56	3.20	1350	**1860**	**1950**	**12.4**
60	3.45	1550	**2130**	**2240**	**14.2**

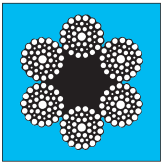
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



IWRC 6 × WS (36) (JIS)
Construction 7 × 7 + 6 × WS [1 + 7 + (7 + 7) + 14]

Rope diameter mm	Outer wire diameter mm	Sectional area mm²	Breaking force Ordinary lay・Lang's lay Bright・Galvanized Grade B kN	Breaking force Ordinary lay・Lang's lay Bright Grade T kN	(Reference) Rough calculation Unit mass kg/m
16	0.92	130	173	182	1.13
18	1.03	164	219	230	1.43
20	1.14	202	**271**	**284**	**1.76**
22.4	1.28	254	**340**	**357**	**2.21**
25	1.43	316	**423**	**444**	**2.75**
28	1.60	397	**531**	**558**	**3.45**
30	1.70	456	**609**	**640**	**3.96**
31.5	1.80	502	**672**	**706**	**4.37**
33.5	1.91	568	**760**	**798**	**4.94**
35.5	2.03	638	**853**	**896**	**5.55**
37.5	2.14	712	**952**	**1000**	**6.19**
40	2.27	810	**1080**	**1140**	**7.04**
42.5	2.40	914	**1220**	**1280**	**7.95**
45	2.58	1030	**1370**	**1440**	**8.91**
47.5	2.70	1140	**1530**	**1600**	**9.93**
50	2.86	1270	**1690**	**1780**	**11.0**
53	3.03	1420	**1900**	**2000**	**12.4**
56	3.20	1590	**2120**	**2230**	**13.8**
60	3.45	1820	**2440**	**2560**	**15.8**

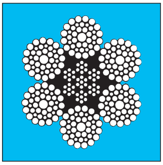
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



6 × WS (41) (JIS)
Construction 6 × WS [1 + 8 + (8 + 8) + 16]

Rope diameter mm	Outer wire diameter mm	Sectional area mm^2	Breaking force: Ordinary lay・Lang's lay — Bright・Galvanized, Grade B, kN	Breaking force: Ordinary lay・Lang's lay — Bright, Grade T, kN	(Reference) Rough calculation Unit mass kg/m
30	1.52	389	**533**	**560**	**3.56**
31.5	1.60	428	**588**	**618**	**3.93**
33.5	1.70	485	**665**	**699**	**4.44**
35.5	1.80	544	**746**	**785**	**4.99**
37.5	1.91	607	**833**	**876**	**5.57**
40	2.03	691	**948**	**996**	**6.33**
42.5	2.14	780	**1070**	**1120**	**7.15**
45	2.30	874	**1200**	**1260**	**8.01**
47.5	2.40	974	**1340**	**1400**	**8.93**
50	2.55	1080	**1480**	**1560**	**9.90**
53	2.70	1210	**1660**	**1750**	**11.1**
56	2.86	1350	**1860**	**1950**	**12.4**
60	3.07	1550	**2130**	**2240**	**14.2**
63	3.20	1710	2350	—	15.7
67	3.40	1940	2660	—	17.8
71	3.60	2180	2990	—	20.0
75	3.80	2430	3330	—	22.3
80	4.05	2760	3790	—	25.3
85	4.34	3120	4280	—	28.6
90	4.60	3500	4800	—	32.1
95	4.87	3900	5350	—	35.7

(Remarks) 1. Dash (—) marks represent those that can be made on request.
2. The figures shown in bold in this chart denote JIS values.



IWRC 6 × WS (41) (JIS)
Construction 7 × 7 + 6 × WS [1 + 8 + (8 + 8) + 16]

Rope diameter mm	Outer wire diameter mm	Sectional area mm²	Breaking force, Ordinary lay・Lang's lay, Bright・Galvanized, Grade B kN	Breaking force, Ordinary lay・Lang's lay, Bright, Grade T kN	(Reference) Rough calculation Unit mass kg/m
30	1.52	456	**609**	**640**	**3.96**
31.5	1.60	502	**672**	**706**	**4.37**
33.5	1.70	568	**760**	**798**	**4.94**
35.5	1.80	638	**853**	**896**	**5.55**
37.5	1.91	712	**952**	**1000**	**6.19**
40	2.03	810	**1080**	**1140**	**7.04**
42.5	2.14	914	**1220**	**1280**	**7.95**
45	2.30	1030	**1370**	**1440**	**8.91**
47.5	2.40	1140	**1530**	**1600**	**9.93**
50	2.55	1270	**1690**	**1780**	**11.0**
53	2.70	1420	**1900**	**2000**	**12.4**
56	2.86	1590	**2120**	**2230**	**13.8**
60	3.07	1820	**2440**	**2560**	**15.8**
63	3.20	2010	2690	—	17.5
67	3.40	2270	3040	—	19.8
71	3.60	2550	3410	—	22.2
75	3.80	2850	3810	—	24.8
80	4.05	3240	4330	—	28.2
85	4.34	3660	4890	—	31.8
90	4.60	4100	5480	—	35.6
95	4.87	4570	6110	—	39.7

(Remarks) 1. Dash (—) marks represent those that can be made on request.
2. The figures shown in bold in this chart denote JIS values.

③ Super-Coat Rope

The wire-ropes include the rope with fibre core and the rope with rope core. In case requiring a high breaking force the ropes with rope core are used, whereas the internal wearing and the internal corrosion take place as to their defect, that results the short life comparing with the ropes with fibre core.

"Super-Coat Rope" employs, in stead of the rope cores in the conventional ropes, the core rope coated with a resin. This coating avoides the side strands and the rope core from the direct contact, so as to prevent from the internal wearing and to reduce the breakage to be occured at the wires, therefore the life of the whole rope is extended.

■ Anti-Fatigue Characteristic

Super-Coat Rope is proven by the fatigue tests the following superior features.

(a) Comparing with conventional ropes, the repeated times in the 10% breakage in a layer have 20% longer, and the life until standard discard is extended.

(b) The ratio of the outside wire breakage shows bigger, and moreover the IWRC wire breakages are remarkably lower, that gives easier visual inspection from outside of the wire-rope.

Fig. 3●Super-Coat Rope appearance

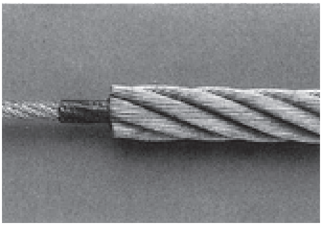
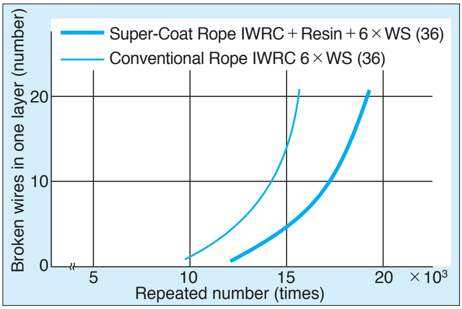
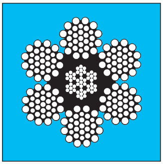


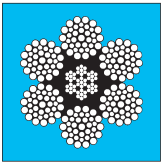
Fig. 4●Result of the fatigue tests





IWRC 6 × WS (31)
Construction 7 × 7 + Resin + 6 × WS [1 + 6 + (6 + 6) + 12]

Rope diameter	Outer wire diameter	Sectional area	Breaking force (Bright・Galvanized) Grade B	Breaking force (Bright・Galvanized) Grade T	(Reference) Rough calculation Unit mass
mm	mm	mm^2	kN	kN	kg/m
16	1.05	130	173	182	1.13
18	1.17	164	219	230	1.43
20	1.30	202	271	284	1.76
22.4	1.45	254	340	357	2.21
25	1.63	316	423	444	2.75
28	1.83	397	531	558	3.45
30	1.94	456	609	640	3.96
31.5	2.06	502	672	706	4.37
33.5	2.17	568	760	798	4.94
35.5	2.30	638	853	896	5.55
37.5	2.44	712	952	1000	6.19
40	2.58	810	1080	1140	7.04
42.5	2.74	914	1220	1280	7.95
45	2.95	1030	1370	1440	8.91
47.5	3.07	1140	1530	1600	9.93
50	3.25	1270	1690	1780	11.0
53	3.45	1420	1900	2000	12.4
56	3.65	1590	2120	2230	13.8
60	3.93	1820	2440	2560	15.8



IWRC 6 × WS (36)
Construction 7 × 7 + Resin + 6 × WS [1 + 7 + (7 + 7) + 14]

Rope diameter mm	Outer wire diameter mm	Sectional area mm²	Breaking force Bright・Galvanized Grade B kN	Breaking force Bright・Galvanized Grade T kN	(Reference) Rough calculation Unit mass kg/m
20	1.14	202	271	284	1.76
22.4	1.28	254	340	357	2.21
25	1.43	316	423	444	2.75
28	1.60	397	531	558	3.45
30	1.70	456	609	640	3.96
31.5	1.80	502	672	706	4.37
33.5	1.91	568	760	798	4.94
35.5	2.03	638	853	896	5.55
37.5	2.14	712	952	1000	6.19
40	2.27	810	1080	1140	7.04
42.5	2.40	914	1220	1280	7.95
45	2.58	1030	1370	1440	8.91
47.5	2.70	1140	1530	1600	9.93
50	2.86	1270	1690	1780	11.0
53	3.03	1420	1900	2000	12.4
56	3.20	1590	2120	2230	13.8
60	3.45	1820	2440	2560	15.8

④Wire Rope with Profile Wires
(Tough-Rope, Tough-Super-Rope)

Tough-Rope and Tough-Super-Rope, among others, of this company are product names of special shape wire strands.

Recently, great advancements are being made in all kinds of industrial equipment and, together with this, the kinds of ropes used are changing from the cross lay rope to the super ropes (parallel lay ropes).

The use of the super rope is widening, testifying to its superiority.

However, the demand for "even higher performance and higher quality ropes" seems to know no end. In order to meet this demand, this company is carrying out research and development on improved types of super ropes.

As a result, this company has succeeded in developing a special shape wire strand rope which, at present, is displaying its merits in various kinds of uses.

As special processing die-forming is carried out on the strands for this rope and the hitherto method where the wires are in linear contact with each other has been changed to one where the wires are in surface contact, the surface of the strand is smooth.

■ Characteristic

(a)High breaking force

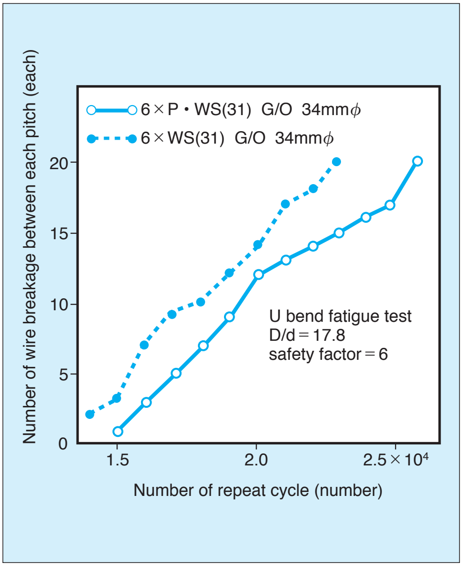
Compared to super ropes with the same diameter, the breaking force is approximately 13～18% larger, thus making the rope stronger.

(b)The fatigue resistance nature is good

As the strands are given a special processing the surface of the strand is smooth and as the lay of the strands are very fine there is no secondary bends and the fatigue resistance nature is superior compared to super topes of the same construction. (See Fig. 5)

However, for example, in the case of a small sheave, around D/d, such as tension test use sheave, the fatigue resistance nature drops and the difference with the general round wire strand ropes practically disappears.

Fig. 5●Comparison of results of the fatigue test



(c)Superior wear resistance nature

As the surface of the strand is smooth, the wear due to the ropes coming into contact with each other, such as rubbing with the drum, with the sheave, or the roller, is small.

(d) Shape crumbling is law

As the strands are finely stranded the surface is smooth. Therefore, the rope winds smoothly around the drum, and the roller, and there is practically no crumbling of the shape.

(e) Drum, sheave, roller damage is low

As the surface of the rope is smooth, it winds smoothly around the drum, the sheave and the roller and the wear and tear of the rope is kept down to a minimum.

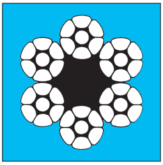
(Note)

1. The flexibility is somewhat low compared to general super ropes of the same construction but this does not hamper its ease of handling.
2. It can be used easily (by attaching and adjusting the ends) the same as the hitherto super ropes.

Main Types and Uses

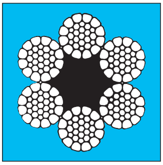
Construction symbol		Main uses
Tough-Rope	6×P･7	Life use, forestry industry ropeway use, inclined shaft winch use, shaft digging guide rope use, cable crane main rope use
Tough-Super-Rope	6×P･Fi(29)	Ropeway stay rope use, general crane use
	IWRC 6×P･Fi(29)	General crane use, heavy equipment use
	6×P･WS(31)	General crane use, fisheries industry trawler use
	IWRC 6×P･WS(31)	General crane use, heavy equipment use
	6×P･WS(36)	General crane use, ropeway stay rope use
	IWRC 6×P･WS(36)	General crane use, ropeway tug rope

(Note) Tough-Rope is the product name of the Tough-Super-Rope used for trawlers of the fisheries industry.



6 × P・7
Construction 6 × P・(1 + 6)

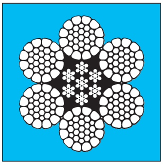
Rope diameter mm	Outer wire diameter mm	Sectional area mm²	Breaking force, Lang's lay, Bright・Galvanized, Grade A kN	Breaking force, Lang's lay, Bright・Galvanized, Grade B kN	(Reference) Rough calculation Unit mass kg/m
12	1.33	68.2	103	112	0.592
12.5	1.39	74.0	112	122	0.643
14	1.56	92.8	141	153	0.806
16	1.78	121	184	200	1.05
18	2.00	153	233	253	1.33
20	2.20	189	287	312	1.65
22	2.44	229	347	378	1.99
22.4	2.48	238	360	392	2.06
24	2.66	273	413	450	2.37
25	2.78	296	449	488	2.57
26	2.86	320	485	528	2.78
28	3.12	371	563	612	3.22
30	3.30	426	646	703	3.70
31.5	3.50	470	712	775	4.08
32	3.55	485	735	800	4.21
33.5	3.70	531	805	876	4.62
34	3.75	547	830	903	4.75
35.5	3.93	597	904	984	5.18
36	4.00	614	930	1010	5.33
37.5	4.16	666	1010	1100	5.78
38	4.22	684	1040	1130	5.94



6 × P・WS (31)
Construction 6 × P・WS [1 + 6 + (6 + 6) + 12]

Rope diameter mm	Outer wire diameter mm	Sectional area mm²	Breaking force, Ordinary lay・Lang's lay, Bright・Galvanized, Grade B, kN	Breaking force, Ordinary lay・Lang's lay, Bright, Grade T, kN	(Reference) Rough calculation Unit mass kg/m
10	0.65	46.5	69.7	75.5	0.424
12	0.79	66.9	100	109	0.611
14	0.92	91.1	137	148	0.831
16	1.05	119	178	193	1.09
18	1.17	151	226	245	1.37
20	1.30	186	279	302	1.70
22	1.43	225	337	366	2.05
22.4	1.45	233	350	379	2.13
24	1.56	268	402	435	2.44
25	1.63	290	436	472	2.65
26	1.68	314	471	511	2.87
28	1.83	364	547	592	3.33
30	1.94	418	627	680	3.82
31.5	2.06	461	692	749	4.21
32	2.08	476	714	773	4.34
33.5	2.17	522	782	848	4.76
34	2.20	537	806	873	4.90
35.5	2.30	586	879	952	5.35
36	2.34	602	904	979	5.50
37.5	2.44	653	980	1060	5.97
38	2.48	671	1010	1090	6.13
40	2.58	744	1120	1210	6.79
42.5	2.74	839	1260	1360	7.66
44	2.86	900	1350	1460	8.21
45	2.95	941	1410	1530	8.59
46	3.00	983	1480	1600	8.98
47.5	3.07	1050	1570	1700	9.57
48	3.12	1070	1610	1740	9.77
50	3.25	1160	1740	—	10.6
52	3.40	1260	1890	—	11.5
53	3.45	1310	1960	—	11.9
54	3.50	1360	2030	—	12.4
56	3.65	1460	2190	—	13.3

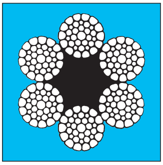
(Remarks) 1. The diameter of a round rope with the same construction is used as a reference for the upper layer strand.
2. Dash (—) marks represent those which can be made on request.



IWRC 6 × P・WS (31)
Construction 7 × 7 + 6 × P・WS [1 + 6 + (6 + 6) + 12]

Rope diameter mm	Outer wire diameter mm	Sectional area mm^2	Breaking force, Ordinary lay・Lang's lay, Bright・Galvanized, Grade B kN	Breaking force, Ordinary lay・Lang's lay, Bright, Grade T kN	(Reference) Rough calculation Unit mass kg/m
10	0.65	53.5	77.4	83.8	0.465
12	0.79	77.0	111	121	0.669
14	0.92	105	152	164	0.911
16	1.05	137	198	215	1.19
18	1.17	173	251	271	1.51
20	1.30	214	309	335	1.86
22	1.43	259	374	406	2.25
22.4	1.45	268	388	420	2.33
24	1.56	308	446	483	2.68
25	1.63	334	484	524	2.91
26	1.68	362	523	566	3.14
28	1.83	419	607	657	3.64
30	1.94	482	696	754	4.18
31.5	2.06	531	768	831	4.61
32	2.08	548	792	858	4.76
33.5	2.17	600	868	940	5.22
34	2.20	618	894	969	5.37
35.5	2.30	674	975	1060	5.86
36	2.34	693	1000	1090	6.03
37.5	2.44	752	1090	1180	6.54
38	2.48	773	1120	1210	6.71
40	2.58	856	1240	1340	7.44
42.5	2.74	966	1400	1510	8.40
44	2.86	1040	1500	1620	9.00
45	2.95	1080	1570	1700	9.41
46	3.00	1130	1640	1770	9.84
47.5	3.07	1210	1750	1890	10.5
48	3.12	1230	1780	1930	10.7
50	3.25	1340	1930	—	11.6
52	3.40	1450	2090	—	12.6
53	3.45	1500	2170	—	13.1
54	3.50	1560	2260	—	13.6
56	3.65	1680	2430	—	14.6

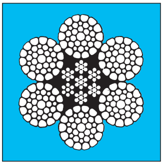
(Remarks) 1. The diameter of a round rope with the same construction is used as a reference for the upper layer strand.
2. Dash (—) marks represent those which can be made on request.



6 × P・WS (36)
Construction 6 × P・WS [1 + 7 + (7 + 7) + 14]

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay・Lang's lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm²	kN	kN	kg/m
20	1.14	186	279	302	1.70
22	1.26	225	337	366	2.05
22.4	1.28	233	350	379	2.13
24	1.37	268	402	435	2.44
25	1.43	290	436	472	2.65
26	1.47	314	471	511	2.87
28	1.60	364	547	592	3.33
30	1.70	418	627	680	3.82
31.5	1.80	461	692	749	4.21
32	1.83	476	714	773	4.34
33.5	1.91	522	782	848	4.76
34	1.94	537	806	873	4.90
35.5	2.03	586	879	952	5.35
36	2.06	602	904	979	5.50
37.5	2.14	653	980	1060	5.97
38	2.17	671	1010	1090	6.13
40	2.27	744	1120	1210	6.79
42.5	2.40	839	1260	1360	7.66
44	2.51	900	1350	1460	8.21
45	2.58	941	1410	1530	8.59
46	2.62	983	1480	1600	8.98
47.5	2.70	1050	1570	1700	9.57
48	2.74	1070	1610	1740	9.77
50	2.86	1160	1740	1890	10.6
52	3.00	1260	1890	2040	11.5
53	3.03	1310	1960	2120	11.9
54	3.07	1360	2030	2200	12.4
56	3.20	1460	2190	—	13.3
58	3.30	1560	2350	—	14.3
60	3.45	1670	2510	—	15.3

(Remarks) 1. The diameter of a round rope with the same construction is used as a reference for the upper layer strand.
2. Dash (—) marks represent those which can be made on request.



IWRC 6 × P・WS (36)
Construction 7 × 7 + 6 × P・WS [1 + 7 + (7 + 7) + 14]

Rope diameter mm	Outer wire diameter mm	Sectional area mm^2	Breaking force, Ordinary lay・Lang's lay, Bright・Galvanized, Grade B, kN	Breaking force, Ordinary lay・Lang's lay, Bright, Grade T, kN	(Reference) Rough calculation Unit mass kg/m
20	1.14	214	309	335	1.86
22	1.26	259	374	406	2.25
22.4	1.28	268	388	420	2.33
24	1.37	308	446	483	2.68
25	1.43	334	484	524	2.91
26	1.47	362	523	566	3.14
28	1.60	419	607	657	3.64
30	1.70	482	696	754	4.18
31.5	1.80	531	768	831	4.61
32	1.83	548	792	858	4.76
33.5	1.91	600	868	940	5.22
34	1.94	618	894	969	5.37
35.5	2.03	674	975	1060	5.86
36	2.06	693	1000	1090	6.03
37.5	2.14	752	1090	1180	6.54
38	2.17	773	1120	1210	6.71
40	2.27	856	1240	1340	7.44
42.5	2.40	966	1400	1510	8.40
44	2.51	1040	1500	1620	9.00
45	2.58	1080	1570	1700	9.41
46	2.62	1130	1640	1770	9.84
47.5	2.70	1210	1750	1890	10.5
48	2.74	1230	1780	1930	10.7
50	2.86	1340	1930	2090	11.6
52	3.00	1450	2090	2270	12.6
53	3.03	1500	2170	2350	13.1
54	3.07	1560	2260	2440	13.6
56	3.20	1680	2430	—	14.6
58	3.30	1800	2600	—	15.6
60	3.45	1930	2780	—	16.7

(Remarks) 1. The diameter of a round rope with the same construction is used as a reference for the upper layer strand.
2. Dash (—) marks represent those which can be made on request.

⑤ Elevator Rope

The elevator ropes are being used not only in Japan but also in many buildings overseas and are receiving a high evaluation.

Recent orders for this company's elevator ropes, in Japan, include the Landmark Tower (290 meters high with 70 stories above ground level and ultra-high speed elevators that travel 750 meters in one minute) and the Tokyo Metropolitan Government Building (243 meters high with 48 stories above ground level and with a total of 83 high speed elevators).

Overseas, our products are being used for the elevators of Sky Central in China, Suntec city in Singapore and the T & C Tower in Taiwan. All of these buildings are high rise buildings and all use high speed elevators. The safety demanded by the even taller buildings and even higher speed elevators is firmly supported by the elevator ropes of this company. Tokyo Rope Mfg. Co., Ltd. with its expertise in elevators of many prominent modern buildings is ready to meet your requirements for elevator ropes.

① **High reliability**

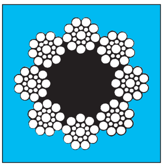
The products made through the concentration of long years of experience and superior technology in rope manufacturing, as well as up-to-date facilities are being used for numerous elevators and being received with high reliability and trust.

② **High quality**

High quality and stability are maintained through the establishment of internal standards and technical levels, as well as the carrying out of advanced quality and process control.

③ **Active research**

The professional and superior research staff are actively engaged in improving the quality of the products through research and study of product characteristics and the results of their study are being reflected in the elevator ropes turned out by this company.

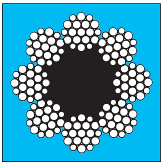


8 × S (19) (JIS)

Construction 8 × S (1 + 9 + 9)

Rope diameter (mm)	Outer wire diameter (mm)	Sectional area (mm^2)	Breaking force — Ordinary lay — Bright・Galvanized — Grade E (kN)	Breaking force — Ordinary lay — Bright・Galvanized — Grade A (kN)	Breaking force — Ordinary lay — Bright — Grade B (kN)	Breaking force — Ordinary lay — Bright — Grade T (kN)	(Reference) Rough calculation Unit mass (kg/m)
8	0.53	23.4	**26.0**	**30.8**	**32.8**	**34.5**	**0.220**
10	0.66	36.5	**40.6**	**48.1**	**51.3**	**53.9**	**0.343**
11.2	0.74	45.8	**51.0**	**60.3**	**64.3**	**67.6**	**0.430**
12	0.80	52.6	**58.5**	**69.2**	**73.8**	**77.7**	**0.494**
12.5	0.83	57.0	**63.5**	**75.1**	**80.1**	**84.3**	**0.536**
14	0.93	71.6	**79.6**	**94.3**	**100**	**106**	**0.672**
16	1.06	93.5	**104**	**123**	**131**	**138**	**0.878**
18	1.19	118	**132**	**156**	**166**	**175**	**1.11**
20	1.32	146	**162**	**192**	**205**	**216**	**1.37**
22.4	1.47	183	**204**	**241**	**257**	**271**	**1.72**
25	1.65	228	**254**	**301**	**320**	**337**	**2.14**

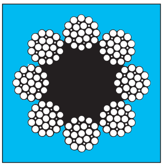
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



8 × W (19) (JIS)
Construction 8 × W [1 + 6 + (6 + 6)]

Rope diameter	Outer wire diameter	Sectional area	Breaking force				(Reference) Rough calculation Unit mass
			Ordinary lay				
			Bright・Galvanized		Bright		
			Grade E	Grade A	Grade B	Grade T	
mm	mm	mm^2	kN	kN	kN	kN	kg/m
8	0.48	23.4	26.0	30.8	32.8	34.5	0.220
10	0.61	36.5	40.6	48.1	51.3	53.9	0.343
11.2	0.68	45.8	51.0	60.3	64.3	67.6	0.430
12	0.73	52.6	58.5	69.2	73.8	77.7	0.494
12.5	0.76	57.0	63.5	75.1	80.1	84.3	0.536
14	0.86	71.6	79.6	94.3	100	106	0.672
16	0.97	93.5	104	123	131	138	0.878
18	1.09	118	132	156	166	175	1.11
20	1.20	146	162	192	205	216	1.37
22.4	1.35	183	204	241	257	271	1.72
25	1.52	228	254	301	320	337	2.14

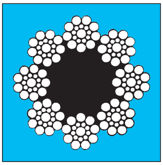
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



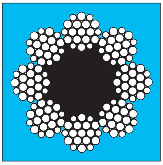
8 × Fi (25) (JIS)
Construction 8 × Fi [1 + 6 + (6) + 12]

Rope diameter	Outer wire diameter	Sectional area	Breaking force				(Reference) Rough calculation Unit mass
			Ordinary lay				
			Bright・Galvanized		Bright		
			Grade E	Grade A	Grade B	Grade T	
mm	mm	mm^2	kN	kN	kN	kN	kg/m
8	0.42	23.4	26.0	30.8	32.8	34.5	0.220
10	0.53	36.5	40.6	48.1	51.3	53.9	0.343
11.2	0.60	45.8	51.0	60.3	64.3	67.6	0.430
12	0.64	52.6	58.5	69.2	73.8	77.7	0.494
12.5	0.67	57.0	63.5	75.1	80.1	84.3	0.536
14	0.75	71.6	79.6	94.3	100	106	0.672
16	0.86	93.5	104	123	131	138	0.878
18	0.96	118	132	156	166	175	1.11
20	1.06	146	162	192	205	216	1.37
22.4	1.19	183	204	241	257	271	1.72
25	1.33	228	254	301	320	337	2.14

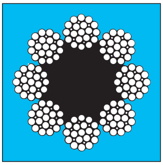
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



8 × S (19) (ISO 4344)
Construction 8 × S (1 + 9 + 9)

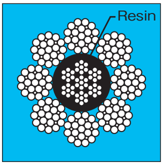


8 × W (19) (ISO 4344)
Construction 8 × W [1 + 6 + (6 + 6)]



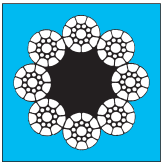
8 × Fi (25) (ISO 4344)
Construction 8 × Fi [1 + 6 + (6) + 12]

Nominal diameter	Breaking force (kN)							Unit mass
	Dual tensile				Single tensile			
mm	Rope grade 1180/1770	Rope grade 1320/1620	Rope grade 1370/1770	Rope grade 1570/1770	Rope grade 1570	Rope grade 1620	Rope grade 1770	kg/m
8	25.7	26.5	28.1	30.8	29.4	30.4	33.2	0.218
9.5	36.2	37.3	39.7	43.6	41.5	42.8	46.8	0.307
10	40.1	41.3	44.0	48.1	46.0	47.5	51.9	0.340
11	48.6	50.0	53.2	58.1	55.7	57.4	62.8	0.411
12	57.8	59.5	63.3	69.2	66.2	68.4	74.7	0.490
12.7	64.7	66.6	70.9	77.5	74.2	76.6	83.6	0.548
13	67.8	69.8	74.3	81.2	77.7	80.2	87.6	0.575
14	78.7	81.0	86.1	94.2	90.2	93.0	102	0.666
16	103	106	113	123	118	122	133	0.870
18	130	134	142	156	149	154	168	1.10
19	145	149	159	173	166	171	187	1.23
20	161	165	176	192	184	190	207	1.36
22	194	200	213	233	223	230	251	1.65

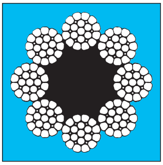


IWRC 8 × Fi (25)
Construction 7 × 7 + Resin + 8 × Fi [1 + 6 + (6) + 12]

Rope diameter	Outer wire diameter	Sectional area	Breaking force (kN)			(Reference) Rough calculation Unit mass
			Ordinary lay			
			Bright・Galvanized		Bright	
			Grade E	Grade A	Grade B	
mm	mm	mm²	kN	kN	kN	kg/m
8	0.42	29.0	33.6	39.6	42.2	0.272
10	0.53	45.3	52.5	61.8	66.0	0.426
11.2	0.60	56.8	65.9	77.5	82.8	0.534
12	0.64	65.2	75.6	89.0	95.0	0.613
12.5	0.67	70.8	82.0	96.6	103	0.665
14	0.75	88.8	103	121	129	0.834
16	0.86	116	134	158	169	1.09
18	0.96	147	170	200	214	1.38
20	1.06	181	210	247	264	1.70
22.4	1.19	227	263	310	331	2.14
25	1.33	283	328	386	413	2.66

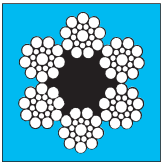


8 × P・S (19) (JIS)
Construction 8 × P・S [1 + 9 + 9]



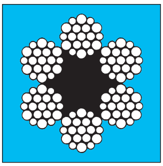
8 × P・Fi (25) (JIS)
Construction 8 × P・Fi [1 + 6 + (6) + 12]

	Rope diameter	Outer wire diameter	Sectional area	Breaking force			(Reference) Rough calculation Unit mass
				Ordinary lay			
				Bright・Galvanized		Bright	
				Grade E	Grade A	Grade B	
	mm	mm	mm^2	kN	kN	kN	kg/m
8×P・S (19) (JIS)	8	0.53	26.4	28.6	33.8	36.1	0.240
	10	0.66	41.3	44.7	52.9	56.4	0.374
	11.2	0.74	51.8	56.0	66.3	70.7	0.470
	12	0.80	59.5	64.3	76.1	81.2	0.539
	12.5	0.83	64.5	69.8	82.6	88.1	0.585
	14	0.93	81.0	87.5	104	110	0.734
	16	1.06	106	114	135	144	0.958
	18	1.19	134	145	171	183	1.21
	20	1.32	165	179	211	225	1.50
	22.4	1.47	207	224	265	283	1.88
	25	1.65	258	279	330	352	2.34
8×P・Fi (25) (JIS)	8	0.42	26.4	28.6	33.8	36.1	0.240
	10	0.53	41.3	44.7	52.9	56.4	0.374
	11.2	0.60	51.8	56.0	66.3	70.7	0.470
	12	0.64	59.5	64.3	76.1	81.2	0.539
	12.5	0.67	64.5	69.8	82.6	88.1	0.585
	14	0.75	81.0	87.5	104	110	0.734
	16	0.86	106	114	135	144	0.958
	18	0.96	134	145	171	183	1.21
	20	1.06	165	179	211	225	1.50
	22.4	1.19	207	224	265	283	1.88
	25	1.33	258	279	330	352	2.34



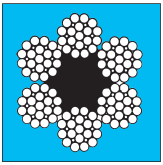
6 × S (19) (JIS)
Construction 6 × S (1 + 9 + 9)

Rope diameter mm	Outer wire diameter mm	Sectional area mm²	Breaking force Ordinary lay Bright・Galvanized Grade E kN	Grade A kN	Grade B kN	(Reference) Rough calculation Unit mass kg/m
6	0.48	14.2	16.1	19.6	20.9	0.139
6.3	0.50	15.7	17.8	21.6	23.0	0.153
8	0.63	25.2	28.6	34.9	37.2	0.247
9	0.72	31.9	36.2	44.1	47.0	0.312
10	0.80	39.4	44.7	54.5	58.1	0.386
11.2	0.89	49.5	56.1	68.3	72.8	0.484
12	0.96	56.8	64.4	78.4	83.6	0.556
12.5	1.00	61.6	69.9	85.1	90.7	0.603
14	1.12	77.3	87.7	107	114	0.756
16	1.28	101	115	139	149	0.988
18	1.43	128	145	176	188	1.25
20	1.58	158	179	218	232	1.54
22.4	1.78	198	224	273	291	1.94
25	2.00	247	280	340	363	2.41



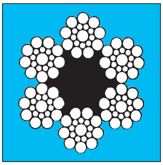
6 × W (19) (JIS)
Construction 6 × W [1 + 6 + (6 + 6)]

Rope diameter mm	Outer wire diameter mm	Sectional area mm²	Breaking force Ordinary lay Bright・Galvanized Grade E kN	Grade A kN	Grade B kN	(Reference) Rough calculation Unit mass kg/m
6	0.45	14.2	16.1	19.6	20.9	0.139
6.3	0.47	15.7	17.8	21.6	23.0	0.153
8	0.59	25.2	28.6	34.9	37.2	0.247
9	0.67	31.9	36.2	44.1	47.0	0.312
10	0.74	39.4	44.7	54.5	58.1	0.386
11.2	0.83	49.5	56.1	68.3	72.8	0.484
12	0.89	56.8	64.4	78.4	83.6	0.556
12.5	0.93	61.6	69.9	85.1	90.7	0.603
14	1.05	77.3	87.7	107	114	0.756
16	1.19	101	115	139	149	0.988
18	1.33	128	145	176	188	1.25
20	1.47	158	179	218	232	1.54
22.4	1.65	198	224	273	291	1.94
25	1.86	247	280	340	363	2.41

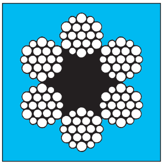


6 × Fi (25) (JIS)
Construction 6 × Fi [1 + 6 + (6) + 12]

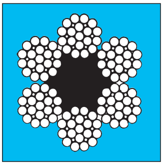
Rope diameter	Outer wire diameter	Sectional area	Breaking force			(Reference) Rough calculation Unit mass
			Ordinary lay			
			Bright・Galvanized			
mm	mm	mm^2	Grade E	Grade A	Grade B	kg/m
			kN	kN	kN	
6	0.39	14.2	16.1	19.6	20.9	0.139
6.3	0.41	15.7	17.8	21.6	23.0	0.153
8	0.51	25.2	28.6	34.9	37.2	0.247
9	0.58	31.9	36.2	44.1	47.0	0.312
10	0.64	39.4	44.7	54.5	58.1	0.386
11.2	0.72	49.5	56.1	68.3	72.8	0.484
12	0.77	56.8	64.4	78.4	83.6	0.556
12.5	0.81	61.6	69.9	85.1	90.7	0.603
14	0.90	77.3	87.7	107	114	0.756
16	1.03	101	115	139	149	0.988
18	1.15	128	145	176	188	1.25
20	1.28	158	179	218	232	1.54
22.4	1.43	198	224	273	291	1.94
25	1.60	247	280	340	363	2.41



6 × S (19) (ISO 4344)
Construction 6 × S (1 + 9 + 9)



6 × W (19) (ISO 4344)
Construction 6 × W [1 + 6 + (6 + 6)]



6 × Fi (25) (ISO 4344)
Construction 6 × Fi [1 + 6 + (6) + 12]

Nominal diameter	Breaking force (kN)							Unit mass
	Dual tensile				Single tensile			
mm	Rope grade 1180/1770	Rope grade 1320/1620	Rope grade 1370/1770	Rope grade 1570/1770	Rope grade 1570	Rope grade 1620	Rope grade 1770	kg/m
6	16.3	16.8	17.8	19.5	18.7	19.2	21.0	0.129
8	28.9	29.8	31.7	34.6	33.2	34.2	37.4	0.230
9.5	40.8	42.0	44.7	48.8	46.8	48.2	52.7	0.324
10	45.2	46.5	49.5	54.1	51.8	53.5	58.4	0.359
11	54.7	56.3	59.9	65.5	62.7	64.7	70.7	0.434
12	65.1	67.0	71.3	77.9	74.6	77.0	84.1	0.517
12.7	72.9	75.0	79.8	87.3	83.6	86.2	94.2	0.579
13	76.4	78.6	83.7	91.5	87.6	90.3	98.7	0.607
14	88.6	91.2	97.0	106	102	105	114	0.704
16	116	119	127	139	133	137	150	0.919
18	146	151	160	175	168	173	189	1.16
19	163	168	179	195	187	193	211	1.30
20	181	186	198	216	207	214	234	1.44
22	219	225	240	262	251	259	283	1.74

⑥ Rotation-Resistant Rope

As a tension works on the rope, a torque arises as the lay of the rope tries to twist in the return direction. To solve the problem of the hoisted load from turning around in the air due to using only one rope, the Z lay rope and the S lay rope are being used in parallel for hauling equipment which of recent years require a larger lifting capability.

However, the hoisting devices have become more compact and smaller in size and so the demand has arisen for a product that will make it possible to carry out the job with only one rope. To meet this demand, this company has developed a rope with a small torque. This rope is receiving high evaluation and is being widely used.

The main non-rotating ropes made by this company are as follows.

●Mono-Rope

This is a rope in which the number of strands used is three to four and the layer core diameter is made smaller than that of the general six strand rope and also where the rotating torque of the rope has been lessened through adjusting the lay pitch. In most cases, the cross sections of the strands are in a shell shape so that the surface of the rope will be smooth.

●Multi-Layer Strand Rope

Strands whose cross sections are round in shape are positioned so that two or more layers face in opposite directions to offset the torque between each layer. There are the following two types.

(1)Hercules Rope

Two layers of round strands are stranded.

(2)Nuflex Rope

Three or more layers of round strands are stranded and thus the breaking force is higher than that of the Hercules rope.

As a rope with a high breaking force, there is the Tough Super Nuflex Rope, the Tough Nuflex Rope in which heterogenous wire strands are stranded.

●Long-Super-Rope

Through adjusting the lay pitch of the rope core super rope strand and the rope, the rotating torque of the rope has been lessened.

Therefore, this rope is used for medium height hoisting cranes.

This rope has the same breaking force as the super rope.

●Rota-Less Rope

Rota-Less Rope is the fittest for Rough-Terrain Cranes. The core of this rope is consisted of the independest strand which lay direction is opposite to the lay direction of the rope.

Therefore the torque of the Rota-Less Rope is smaller than that of same construction rope with IWRC.

The fatigue Resistance and flexibility of the Rota-Less Rope are almost equal to the same construction rope with IWRC.

(Reference)

●Definition of Non-Rotating

The definition of the non-rotating nature up to now was not clear but the Japan Steel Rope Industrial Circle has clarified the definition as follows.

(a) Definition according to the torque angle

When a tension of 20% of the standard breaking force is applied to the bottom end of a dangling rope whose other end is fixed, or to the free end of a rope whose other end is fixed horizontally to a tension tester, the torque angle (θ) is less than 40° of the span which is 10 times the diameter of the rope.

(Note) General ropes are $\theta = 120 \sim 200°$

(b) Definition according to the torque

When a weight (W) is applied to the free end of a rope fixed horizontally to a tension tester, the torque (T) arising in the rope is measured. The calculation according to the following formula is for torque coefficient (K) which is less than 30×10^{-3}.

$$K = \frac{T}{W \times D} \times 10^3$$

Here: W = The tension applied to the rope (N)

T = Torque due to the weight W (N・m)

D = Rope diameter (mm)

(Note) General ropes are $K \fallingdotseq 90 \sim 110 \times 10^{-3}$

The smaller the torque coefficient K value the less the rope will tend to twist. The K value by the rope construction is shown in Table 1.

Table 1●Torque coefficient (K) by rope construction

Rope construction		Torque Coef. K($\times 10^{-3}$)	Remarks
Classification	Examples of construction		
3-strand Mono-Rope	3×F(40)	5～15	Non-rotating ropes
4-strand Mono-Rope	4×F(40)	10～20	
Nuflex, Hercules Rope	P・S(19)+39×P・7 19×7	10～20	
Rota-Less Rope	SeS(48)+6×WS(31)	40～60	Low-rotating ropes
Long Super Rope	IWRC6×WS(36)	50～70	
Super Rope	IWRC6×WS(36)	80～100	

■ Cautions When Using

Of the non-rotating ropes, attention should be paid to the following points, particularly as concerns the multi-layer strand ropes, the Hercules rope and the Nuflex rope.

If care is not taken, the shape of the rope will change beyond repair (bird-caging, etc.) and in some extreme cases, the rope will develop kinks and will not be able to withstand the use.

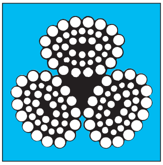
(a) Care should be taken at the time of pulling the rope out of the wooden frame and when attaching to the equipment, or device, so that the lay of the rope will not twist or become loose.

(b) The end of the rope should always be fixed so that the rope will not turn freely, after attaching. (However, this will not apply in the case of unifilar suspension)

(c) Should the rope become harmed due to the groove of the sheave being too small, or the groove being off center, or the turning become poor, the pitch will change and the rope may lose its shape.

Care should be taken so that the rope does not become harmed or damaged.

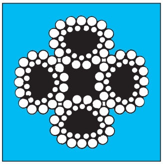
(d) When cutting the rope to the required length, a seizing should first be applied to both sides of the place cut.



Mono-Rope EP
3 × F (40)
Construction 3 × F [a + 8 + (8 + 8) + 16]

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm²	kN	kN	kg/m
10	0.80	47.0	78.9	85.5	0.436
11.2	0.89	58.9	99.0	107	0.547
12	0.96	67.6	114	123	0.628
12.5	1.00	73.6	123	134	0.681
14	1.12	92.1	155	168	0.855
16	1.28	120	202	219	1.12
18	1.43	152	256	277	1.41
20	1.58	188	316	342	1.74
22	1.75	227	382	414	2.11
22.4	1.78	236	396	429	2.19
24	1.91	271	455	493	2.51
25	2.00	294	493	535	2.73
26	2.06	318	533	578	2.95
28	2.24	368	619	670	3.42
30	2.37	423	710	770	3.92
31.5	2.51	466	783	849	4.33
32	2.55	481	808	876	4.47
33.5	2.66	527	886	960	4.89
34	2.70	543	912	989	5.04
35.5	2.82	592	994	1080	5.50
36	2.86	609	1020	1110	5.65
37.5	3.00	661	1110	1200	6.13
38	3.03	678	1140	1230	6.30
40	3.16	752	1260	—	6.98
42.5	3.35	848	1430	—	7.88

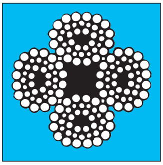
(Remarks) Dash (—) marks represent those that can be made on request.



Mono-Rope A
4 × F (30)
Construction 4 × F (a + 15 + 15)

Rope diameter	Outer wire diameter	Sectional area	Breaking force, Ordinary lay, Bright · Galvanized, Grade B	Breaking force, Ordinary lay, Bright, Grade T	(Reference) Rough calculation Unit mass
mm	mm	mm^2	kN	kN	kg/m
8	0.57	24.1	36.0	39.0	0.221
9	0.65	30.4	45.5	49.3	0.279
10	0.72	37.6	56.2	60.9	0.345
11.2	0.81	47.2	70.5	76.4	0.432
12	0.87	54.1	81.0	87.7	0.496
12.5	0.90	58.7	87.9	95.2	0.539
14	1.02	73.7	110	119	0.676
16	1.15	96.2	144	156	0.882
18	1.30	122	182	197	1.12
20	1.43	150	225	244	1.38
22	1.58	182	272	295	1.67
22.4	1.60	189	282	306	1.73
24	1.73	217	324	351	1.99
25	1.80	235	351	381	2.15
26	1.86	254	380	412	2.33
28	2.03	295	441	478	2.70
30	2.14	338	506	548	3.10
31.5	2.27	373	558	604	3.42
32	2.30	385	576	624	3.53
33.5	2.40	422	631	684	3.87
34	2.44	435	650	704	3.98
35.5	2.55	474	709	768	4.34
36	2.58	487	729	789	4.47
37.5	2.70	529	791	857	4.85
38	2.74	543	812	880	4.98
40	2.86	601	900	975	5.52
42.5	3.03	679	1020	1100	6.23
44	3.16	728	1090	—	6.67
45	3.25	761	1140	—	6.98

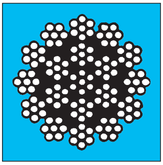
(Remarks) Dash (—) marks represent those that can be made on request.



Mono-Rope SP
4 × F (40)
Construction 4 × F [a + 8 + (8 + 8) + 16]

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm²	kN	kN	kg/m
8	0.53	29.0	43.0	46.5	0.258
9	0.61	36.7	54.4	58.9	0.327
10	0.67	45.3	67.1	72.7	0.403
11.2	0.75	56.8	84.2	91.2	0.506
12	0.81	65.2	96.7	105	0.581
12.5	0.84	70.8	105	114	0.630
14	0.95	88.7	132	143	0.790
16	1.08	116	172	186	1.03
18	1.20	147	218	236	1.31
20	1.33	181	269	291	1.61
22	1.47	219	325	352	1.95
22.4	1.50	227	337	365	2.02
24	1.60	261	387	419	2.32
25	1.68	283	420	455	2.52
26	1.73	306	454	492	2.73
28	1.88	355	526	570	3.16
30	2.00	408	604	655	3.63
31.5	2.11	449	666	722	4.00
32	2.14	464	687	745	4.13
33.5	2.24	508	753	816	4.52
34	2.27	523	776	841	4.66
35.5	2.37	571	846	917	5.08
36	2.40	587	870	943	5.23
37.5	2.51	637	944	1020	5.67
38	2.55	654	969	1050	5.82
40	2.66	724	1070	1160	6.45
42.5	2.82	818	1210	1310	7.28

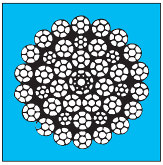
(Remarks) Dash (—) marks represent those that can be made on request.



Hercules Rope
19 × 7 (JIS)
Construction 7 + 6 × 7 + 12 × 7

Rope diameter mm	Outer wire diameter mm	Sectional area mm^2	Breaking force, Ordinary lay, Galvanized, Grade A, kN	Breaking force, Ordinary lay, Bright・Galvanized, Grade T, kN	(Reference) Rough calculation Unit mass kg/m
10	0.66	48.1	58.8	71.7	0.425
11.2	0.74	60.3	73.8	89.9	0.533
12	0.80	69.2	**84.7**	103	**0.612**
14	0.93	94.2	**115**	140	**0.833**
16	1.06	123	**151**	184	**1.09**
18	1.19	156	**191**	232	**1.38**
20	1.32	192	**235**	287	**1.70**
22	1.45	233	**285**	347	**2.06**
25	1.65	300	368	448	2.66
28	1.86	377	461	562	3.33

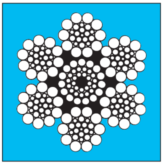
(Remarks) 1. The figures shown in bold in this chart denote JIS values.



Tough-Nuflex-Rope
P・S (19) + 39 × P・7
Construction P・{S (19) + 7 × P・7 + [(7 × P・7) + (7 × P・7)] + 18 × P・7}

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay		
			Bright		
			Grade B	Grade T	
mm	mm	mm^2	kN	kN	kg/m
16	0.76	150	207	225	1.29
18	0.86	189	262	284	1.63
20	0.95	234	324	351	2.02
22	1.05	283	392	425	2.44
22.4	1.06	293	406	440	2.53
24	1.14	336	466	505	2.90
25	1.19	365	506	549	3.15
26	1.22	395	547	593	3.41
28	1.33	458	634	688	3.95
30	1.41	526	728	790	4.54
31.5	1.50	579	803	871	5.00
32	1.52	598	828	899	5.16
33.5	1.58	655	908	985	5.66
34	1.60	675	935	1010	5.83
35.5	1.68	736	1020	1110	6.35
36	1.70	757	1050	1140	6.53
37.5	1.78	821	1140	1230	7.09
38	1.80	843	1170	1270	7.28
40	1.88	934	1290	1400	8.06

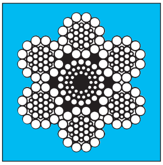
(Remarks) 1. The diameter of a round rope with the same construction is used as a reference for the outer wire strand.
2. Higher breaking force can be made on request, as required.



Rota-Less Rope
IWSC [SeS (39)] 6 × WS (26)
Construction SeS (a+ 9 + 15 + 15) + 6 × WS [1 + 5 + (5 + 5) + 10]

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm^2	kN	kN	kg/m
8	0.60	31.6	42.4	44.5	0.275
9	0.68	40.0	53.6	56.3	0.348
10	0.75	49.4	66.2	69.5	0.430
11.2	0.84	61.9	83.0	87.2	0.539
12.5	0.95	77.1	103	109	0.672
14	1.06	96.7	130	136	0.843
16	1.20	126	169	178	1.10
18	1.35	160	214	225	1.39
20	1.50	197	265	278	1.72
22.4	1.68	248	332	349	2.16
25	1.88	309	414	435	2.69
28	2.11	387	519	545	3.37
30	2.24	444	596	626	3.87
31.5	2.37	490	657	690	4.27
33.5	2.51	554	743	780	4.83
35.5	2.66	622	834	876	5.42
37.5	2.82	694	931	978	6.05
40	3.00	790	1060	1110	6.88
42.5	3.16	892	1200	—	7.77
45	3.40	1000	1340	—	8.71
47.5	3.55	1110	1490	—	9.70
50	3.75	1230	1650	—	10.8

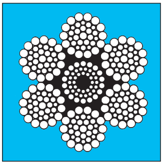
(Remarks) Dash (—) marks represent those that can be made on request.



Rota-Less Rope
IWSC [SeS (48)] 6 × WS (31)
Construction SeS (a+ 12 + 18 + 18) + 6 × WS [1 + 6 + (6 + 6) + 12]

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm²	kN	kN	kg/m
16	1.05	130	173	182	1.13
18	1.17	164	219	230	1.43
20	1.30	202	271	284	1.76
22.4	1.45	254	340	357	2.21
25	1.63	316	423	444	2.75
28	1.83	397	531	558	3.45
30	1.94	456	609	640	3.96
31.5	2.06	502	672	706	4.37
33.5	2.17	568	760	798	4.94
35.5	2.30	638	853	896	5.55
37.5	2.44	712	952	1000	6.19
40	2.58	810	1080	1140	7.04
42.5	2.74	914	1220	1280	7.95
45	2.95	1030	1370	1440	8.91
47.5	3.07	1140	1530	1600	9.93
50	3.25	1270	1690	—	11.0
53	3.45	1420	1900	—	12.4
56	3.65	1590	2120	—	13.8
60	3.93	1820	2440	—	15.8

(Remarks) Dash (—) marks represent those that can be made on request.

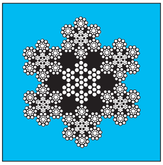


Rota-Less Rope
IWSC [SeS (48)] 6 × WS (36)
Construction SeS (a+ 12 + 18 + 18) + 6 × WS [1 + 7 + (7 + 7) + 14]

Rope diameter	Outer wire diameter	Sectional area	Breaking force		(Reference) Rough calculation Unit mass
			Ordinary lay		
			Bright・Galvanized	Bright	
			Grade B	Grade T	
mm	mm	mm^2	kN	kN	kg/m
16	0.92	130	173	182	1.13
18	1.03	164	219	230	1.43
20	1.14	202	271	284	1.76
22.4	1.28	254	340	357	2.21
25	1.43	316	423	444	2.75
28	1.60	397	531	558	3.45
30	1.70	456	609	640	3.96
31.5	1.80	502	672	706	4.37
33.5	1.91	568	760	798	4.94
35.5	2.03	638	853	896	5.55
37.5	2.14	712	952	1000	6.19
40	2.27	810	1080	1140	7.04
42.5	2.40	914	1220	1280	7.95
45	2.58	1030	1370	1440	8.91
47.5	2.70	1140	1530	1600	9.93
50	2.86	1270	1690	1780	11.0
53	3.03	1420	1900	2000	12.4
56	3.20	1590	2120	—	13.8
60	3.45	1820	2440	—	15.8

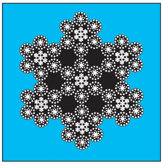
(Remarks) Dash (—) marks represent those that can be made on request.

⑦ Cable Laid Rope



IWRC 6×[IWRC 6×S (19)]
Construction 7×7+6×[7×7+6×S (1+9+9)]

Rope diameter	Outer wire diameter	Sectional area	Breaking force			(Reference) Rough calculation Unit mass
			Ordinary lay			
			Bright			
			Grade A	Grade B	Grade T	
mm	mm	mm^2	kN	kN	kN	kg/m
40	1.08	636	762	817	872	5.65
42.5	1.14	717	860	922	985	6.38
44	1.19	769	922	989	1060	6.84
45	1.22	804	964	1030	1100	7.15
46	1.24	840	1010	1080	1150	7.47
47.5	1.28	896	1070	1150	1230	7.97
48	1.30	915	1100	1180	1260	8.14
50	1.35	993	1190	1280	1360	8.83
52	1.41	1070	1290	1380	1470	9.55
53	1.43	1120	1340	1430	1530	9.92
54	1.45	1160	1390	1490	1590	10.3
56	1.52	1250	1490	1600	1710	11.1
58	1.56	1340	1600	1720	1830	11.9
60	1.63	1430	1710	1840	1960	12.7
62	1.68	1530	1830	1960	2100	13.6
63	1.70	1580	1890	2030	2160	14.0
64	1.73	1630	1950	2090	2230	14.5
67	1.80	1780	2140	2290	2450	15.9
71	1.91	2000	2400	2570	2750	17.8
75	2.03	2230	2680	2870	3070	19.9
80	2.14	2540	3050	3270	3490	22.6
85	2.30	2870	3440	3690	3940	25.5
90	2.44	3220	3860	4140	4420	28.6
95	2.58	3580	4300	4610	4920	31.9
100	2.70	3970	4760	5110	5450	35.3



7 × [IWRC 6 × WS (36)]
Construction 7 × {7 × 7 + 6 × WS [1 + 7 + (7 + 7) + 14] }

Rope diameter	Outer wire diameter	Sectional area	Breaking force			(Reference) Rough calculation Unit mass
			Ordinary lay			
			Bright			
			Grade A	Grade B	Grade T	
mm	mm	mm^2	kN	kN	kN	kg/m
100	1.86	3920	4560	4970	5240	35.0
106	1.97	4400	5120	5580	5880	39.4
112	2.08	4910	5710	6230	6570	43.9
118	2.20	5450	6340	6920	7290	48.8
120	2.24	5640	6560	7160	7540	50.4
125	2.34	6120	7120	7760	8180	54.7
130	2.40	6620	7700	8400	8850	59.2
132	2.48	6930	7940	8660	9120	61.0
140	2.62	7670	8930	9740	10300}	68.7
150	2.78	8810	10200	11200	11800	78.8
160	3.00	10000	11700	12700	13400	89.7
170	3.16	11300	13200	14400	—	101
180	3.35	12700	14800	16100	—	113
190	3.55	14100	16400	17900	—	126
200	3.70	15700	18200	19900	—	140

(Remarks) Dash (—) marks represent those that can be made on request.

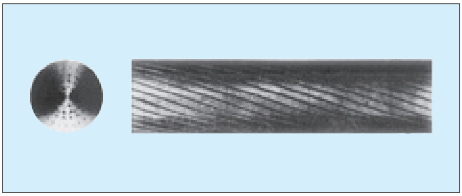
⑧Locked Coil Rope (for rails)

The locked coil rope was conceived and patented by Bachelor, in 1884. Since then, the construction of this rope has become more and more complex. In Japan, also, the locked coil rope is being widely used as the main rope for cable cranes, passenger ropeways and cargo ropeways and its superiority is highly evaluated.

This company is constantly making efforts to improve its rope making technology and to turn out uniform quality. As a result, the ropes of this company are being widely used because of their superior quality.

The locked coil rope is made up of grades A, B, C, D, F and G. Each of these grades has as its core a round wire multilayer lay rope as the core (referred to as the lower layer rope herein). Heterogenous wire is meshed closely around this core and a special rope grease applied to the inner and the outer layers.

Fig. 6●Exterior view and cross sectional view of the locked coil rope



Characteristics

(a)Low vibration and noise

The surface of the rope is smooth like a rod and so there is little vibration when the conveyor is travelling on the rail rope (stay rope, main rope, axial rope). Therefore, the wear on the conveyor, towers, and the other facilities, in general, is small and as the noise is low, the ride on the passenger ropeway is comfortable.

(b)Superior in its wear resistance

The locked coil rope has an excellent wear resistance and so its life expectancy is extremely long.

(c)High strength against bending

A rope that does not bend easily is required when using for axial ropes such as for cable cranes. The locked coil rope uses a Z grade and T grade heterogenous wire, which differs from the round wire, for the outer layer and so is ideal for using for these purposes.

(d)Highly Corrosion resistant

Internal rusting due to rain water over many years cannot be avoided for Hercules ropes and flat type ropes, even though grease may be applied. However, the heterogenous wires of the locked coil rope are closely matched for the locked coil rope and grease is fully applied at the time of manufacture and so rain water and moisture is prevented from entering and there is no fear of internal rusting.

(e)Large breaking force

Compared to other ropes with the same diameter, its breaking force is much greater.

Type and Construction

Type	Construction
A type	An X type heterogenous wire and a round wire are combined alternately around the lower layer rope and so a single layer lay made. This is also called semi-locked coil rope. (Not used in Japan)
B type	A Z type heterogenous wire layer is stranded around the lower layer rope to make a single layer lay.
C type	A T type heterogenous wire layer is stranded around the lower layer rope and after making a single layer lay a Z type heterogenous wire is stranded around this.
D type	A single layer a Z type wire is further placed around the C type rope.
E type	Two layers of T type heterogenous wires are stranded around the lower layer rope and then a further two layers of Z type heterogenous wire placed over this.
F type	A further one layer of Z type heterogenous wire is stranded around the E type rope.
G type	A further one layer of Z type heterogenous wire is stranded around the F type rope.

Concerning The Superiority of The Locked Coil Rope of This Company

(a)Tradition and superior technology

From the time this company started to deliver 300 meter length B type 38mm diameter ropes to the Hitachi mines, in 1941, to the present this company has produced approximately 25,000 tons of ropes.

During this period, this company led the other companies in taking in hand research on locked coil ropes. Through improving its technology, the quality of the products turned out by this company is, today, leaving the other companies far behind.

Using a 1,000-ton rope tension tester, this company is carrying out tests on the performance of large diameter locked coil ropes.

Based on the data obtained form these tests, further improvements are being made on the quality of the locked coil ropes. Even today, technical research is being carried out without rest.

(b)Ultra-hard alloy dies with a high precision

Of first importance when deciding on the quality of the locked coil rope, is to see that the precision designed heterogenous wires mesh precisely.

As the result of many years of research, this company has succeeded in perfecting the highly accurate electric discharge processing method. Through this method, the wires can be drawn to the designed shape and the die is of an extremely high accuracy.

Based on the manufacturing experience it has gained up to now, exceeding a cumulative 25,000 tons, this company is employing the most ideal heterogenous wire not only from the logical point of view but also from the aspect of actual use.

(c)Special lay wire machine

Perfect quality locked coil ropes can be made only through the use of a specially designed machine, when looked at from its construction.

This company, together with the popularization of the locked coil ropes and the greater use of large size ropes, imported the latest large-size locked coil lay wire machine, from Germany, in 1954.

And, in 1972, to meet the demands for even longer ropes added an up-to-date domestically made machine with a large capacity bobbin window.

(d)Others

This company can also make locked coil ropes with a special zinc coating, on request, to prevent corrosion.

Points to be Observed When Using

This locked coil rope is expensive and also heavy (large mass per unit) and so attention should be paid to the following when using.

(a)Points to be observed when pulling the rope from the spool, or reel (wood or steel frame)

(1)The spool stand should be placed on a level spot where there is good footing.

This is necessary to ensure the safety of the workers and also to prevent the rope from becoming damaged.

(2)The spool stand should be anchored in the reverse direction to that of the pulling direction.

This is necessary to prevent the stand from toppling over.

(3)A brake should be attached to adjust the revolution of the spool.

If the rope is pulled out without applying a brake, the rope will reel out too quickly, thus causing the rope to become fatally damaged. There is also the danger of accident to the user.

(4)Pull the rope out from the bottom side of the spool.

If the rope is pulled out from the top side, a slack may develop in the rope.

(5)The rope being pulled out should be prevented from twisting.

Should the rope turn and the lay of the rope change through twisting, waviness, bending, birdcaging and, in some extreme cases, a kink will develop in the rope and the rope will become unusable.

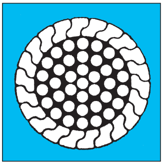
(6)Do not make small bends in the rope. (When bending, the radius of the curvature should be more than 40 times the diameters of the rope.)

If less than 40 times the diameter, a permanent twist will form in the rope.

(b)Other points to be observed

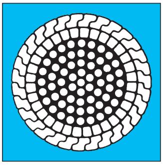
When cutting the rope to the required length, a seizing should be applied to both sides of the place to be cut.

If no seizing is used, the rope will become loose and it will become difficult to return the rope to its former shape.



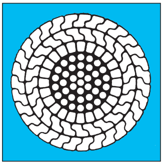
B Type Locked Coil Rope for Rails

Rope diameter mm	Sectional area mm²	Ordinary type		Strong type		(Reference) Rough calculation Unit mass kg/m
		Mean tensile strength N/mm²	Breaking force kN	Mean tensile strength N/mm²	Breaking force kN	
20	280	1450	361	1550	385	2.38
22	339	1450	438	1560	471	2.83
24	401	1460	522	1580	563	3.35
26	473	1460	613	1570	660	3.96
28	546	1430	695	1550	753	4.56
30	598	1510	804	1610	854	5.03
32	680	1500	907	1620	981	5.73
34	762	1520	1030	1620	1100	6.42
36	849	1510	1140	1610	1220	7.15
38	941	1510	1270	1590	1330	7.93
40	1040	1470	1360	1570	1450	8.76
42	1140	1480	1500	1590	1610	9.64
44	1250	1480	1650	1590	1770	10.5
46	1360	1510	1820	1590	1920	11.5



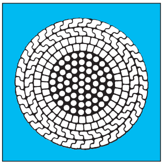
C Type Locked Coil Rope for Rails

Rope diameter mm	Sectional area mm²	Ordinary type		Strong type		(Reference) Rough calculation Unit mass kg/m
		Mean tensile strength N/mm²	Breaking force kN	Mean tensile strength N/mm²	Breaking force kN	
34	808	1400	1000	1590	1140	6.81
36	901	1380	1110	1570	1260	7.59
38	993	1390	1230	1580	1390	8.36
40	1100	1400	1360	1590	1540	9.23
42	1200	1400	1500	1600	1710	10.2
44	1320	1410	1650	1610	1870	11.1
46	1430	1430	1820	1610	2050	12.1
48	1560	1430	1960	1620	2220	13.1
50	1680	1450	2150	1630	2400	14.2
52	1810	1450	2300	1640	2600	15.3
54	1940	1450	2470	1640	2790	16.4
56	2110	1440	2680	1600	2960	17.8
58	2270	1440	2870	1590	3170}	19.1
60	2410	1460	3090	1600	3380	20.4
62	2570	1450	3290	1560	3530	21.7
64	2740	1420	3430	1550	3730	23.1
66	2910	1410	3610	1540	3940}	24.5



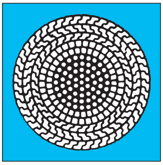
D Type Locked Coil Rope for Rails

Rope diameter mm	Sectional area mm^2	Ordinary type		Strong type		(Reference) Rough calculation Unit mass kg/m
		Mean tensile strength N/mm^2	Breaking force kN	Mean tensile strength N/mm^2	Breaking force kN	
50	1750	1390	2150	1460	2260	14.8
52	1890	1380	2300	1430	2400	16.0
54	2020	1390	2470	1440	2560	17.1
56	2180	1390	2670	1460	2790	18.4
58	2340	1390	2870	1430	2950	19.7
60	2500	1400	3080	1430	3160	21.0
62	2660	1400	3290	1460	3420	22.4
64	2830	1390	3470	1450	3610	23.8
66	3000	1400	3710	1450	3820	25.3
68	3190	1390	3920	1430	4020	26.9
70	3380	1390	4150	1440	4280	28.5
72	3560	1400	4400	1440	4510	30.0
74	3760	1400	4640	1450	4810	31.7
76	3960	1400	4890	1450	5060	33.4



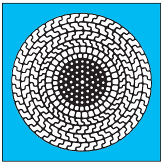
E Type Locked Coil Rope for Rails

Rope diameter mm	Sectional area mm^2	Ordinary type		Strong type		(Reference) Rough calculation Unit mass kg/m
		Mean tensile strength N/mm^2	Breaking force kN	Mean tensile strength N/mm^2	Breaking force kN	
78	4260	1340	4980	1440	5330	35.9
80	4480	1340	5210	1430	5580	37.8
82	4680	1330	5420	1430	5830	39.5
84	4910	1320	5660	1410	6040	41.4
86	5140	1310	5890	1400	6280	43.4
88	5370	1320	6160	1390	6510	45.3
90	5600	1310	6370	1390	6810	47.2
92	5840	1330	6780	1400	7140	49.3
94	6100	1300	6920	1410	7470	51.4
96	6360	1290	7180	1400	7770	53.6
98	6620	1290	7480	1410	8110	55.8
100	6870	1300	7700	1410	8420	57.9



F Type Locked Coil Rope for Rails

Rope diameter mm	Sectional area mm²	Ordinary type		Strong type		(Reference) Rough calculation Unit mass kg/m
		Mean tensile strength N/mm²	Breaking force kN	Mean tensile strength N/mm²	Breaking force kN	
92	6000	1320	6890	1360	7140	50.6
94	6250	1290	7040	1370	7470	52.7
96	6500	1290	7310	1370	7770	54.8
98	6770	1280	7580	1370	8110	57.1
100	7040	1280	7860	1370	8420	59.4



G Type Locked Coil Rope for Rails

Rope diameter mm	Sectional area mm²	Ordinary type		Strong type		(Reference) Rough calculation Unit mass kg/m
		Mean tensile strength N/mm²	Breaking force kN	Mean tensile strength N/mm²	Breaking force kN	
102	7390	1270	8120	1350	8690	62.3
104	7680	1270	8450	1350	9010	64.9
106	7970	1270	8800	1340	9340	67.2
108	8290	1270	9140	1340	9670	69.9
110	8590	1250	9280	1340	10000	72.4
112	8890	1240	9580	1330	10300	75.0
114	9200	1240	9900	1330	10700	77.5
116	9520	1240	10200	1330	11100	80.3
118	9840	1240	10600	1330	11400	83.0
120	10140	1240	10900	1330	11800	85.6

⑨ ZINCAL Rope

In general, the wires or wire ropes are rather easy to be effected by corrosion owing to their large surface area per a unit weight comparing with other construction steel materials. This nature is unavoidable because of the required technical characteristics upon the wires and wire ropes, therefore when to be used under corrosive environment, a certain effective anti-corrosion measure should be taken.

For the wire high carbon steel products in general, galvanizing has been applied for anti-corrosion, however, as for the easier maintenance, the reduction of the working costs, and so on, the more sufisticated plating technique is now-a-days required.

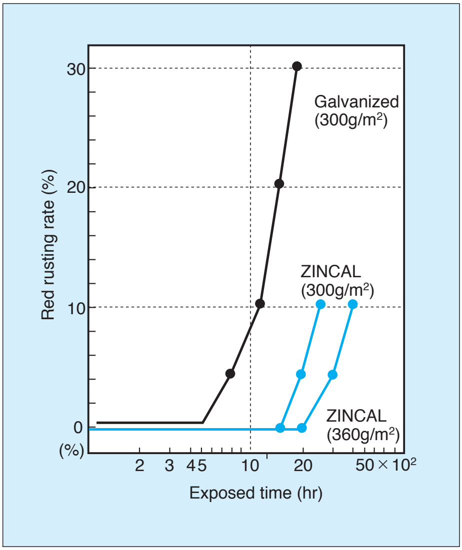
Hereupon, Tokyo Rope has developed a new coating method based on zinc and aluminum, by our qualified surface technology, i. e.,

Zn + 5% A1 + Na Alloy Coating

which creates a remarkable anti-corrosion characteristics, and the wire products manufactured under this new technique is named ZINCAL that is mow introduced into the market.

ZINCAL is recognized as twice or more longer time till getting red rusting by neutral salt spray testing, comparing with galvanized wire of the equal coating mass. Moreover, ZINCAL shows lower increasing rate of the red rusting.

Fig. 7●Salt Result of spray testing
(wire diameter 2.3mmφ)



① TOYO-LOK (Patent No. 233647, Utility Model No. 703649)

Ropes are rarely used as is and the ends are usually processed.

Apart from the conventional splicing, the process-ing methods include TOYO-LOK processing, Single Lock processing and the socket processing with each method having its respective merits.

TOYO-LOK is the product name of a product of this company whose ends have been processed through compression prevention. This company has for many years carried out research and study as concerns processing the ends of ropes. In 1957, a technical agreement was signed with TALURIT of Germany and the patent rights for this product was received. Sales of the product was carried out under the product name TOYO-LOK.

Later, through improvements made in processing technologies, the product was further improved and through strict quality control the product is today receiving high trust and evaluation from many fields.

Characteristics

As the alloy adheres to the strands and to the outer layer wires as though it has been melted on there is no gaps, or openings, in the circumference of the rope. This is a powerful bonding method that prevents the rope from pulling out, even though the rope may break through friction between the alloy and the rope, or between rope and rope. This alloy has the following characteristics.

(a)A high degree of binding power

Maintains more than 95% of the nominal breaking force of the rope and so the rope can be used without anxiety (approved by the Industrial Safety Research Center of the Ministry of Labor).

(b)Accurate mechanical processing

As mechanical processing is carried out, the rope is processed uniformly and the finish measurement is accurate.

(c)High corrosion resistance nature

The special aluminum alloy completely adheres even to the gaps and opening of the wires and so rain water and salt water is kept out and the inside is always like new. However, when used for a long time in sea water the tube may become dissolved and the binding power will drop. In some extreme cases, the rope may pull out.

Please consult this company in such cases.

(d)Prevention of injury

The processed part is covered with a smooth aluminum alloy and so does not injure the hand of the user.

(e)Smart appearance

When used as a stay rope for buildings and structures, the appearance is more stylish than when compared to other processing methods.

Processing Method

An aluminum alloy heterogenous tube is inserted into the connecting part of the rope and compressed from the outside. And, through plastic deforma-tion is adhered to the rope to provide a powerful binding power.

Kinds of Rope slings

Among the TOYO-LOK processed rope slings, there are the following types.

(a)Ordinary rope slings

This is the most general type of rope slings and, as shown in Fig. 1, both ends have an eye part.

Depending on the shape of the eye used, there is the cylindrical type and the streamline type.

(b)Non-torsion rope slings

To prevent the rope slings from turning around when lifting a load, two ropes are used between the processed part, as shown in Fig. 2.

Apart from the two similar type ropes, there is also the S lay and the Z lay ropes which have been made into one.

(c)Eared rope slings (Utility model 503804).

This is shaped as shown in Fig. 3.

(d)Endless rope slings

As shown in Fig. 4, both ends of the ropes overlap each other and processed with TOYO-LOK.

Moreover, the fibre core rope is generally used as the standard item for the various kinds of rope slings, mentioned above. However, rope core (IWRC) ropes and common core (IWSC) ropes can also be made.

Alloy tubes with an inclined end can also be made so that the rope slings can be removed easily after the unloading work is completed.

Your orders are awaited.

Manufacturing Scope

The standard for the scope of manufacturing is as shown in Table 1.

Please consult this company for measurements other than shown here.

Table 1●Standard Manufacturing Scope

<table>
<tr><th colspan="2">Kinds</th><th>Rope</th><th>Rope diameters that can be made mm</th><th>Minimum manufacturing length</th></tr>
<tr><td rowspan="4">Ordinary rope slings</td><td rowspan="2">Cylindrical</td><td>Fibre core</td><td>Over 6 and less than 180</td><td rowspan="10"><table><tr><th>Rope diameter range mm</th><th>Rope multiple</th></tr><tr><td>Less than 50</td><td>40</td></tr><tr><td>Over 50 and less than 56</td><td>50</td></tr><tr><td>Over 56 and less than 65</td><td>60</td></tr><tr><td>over 65</td><td>80</td></tr></table></td></tr>
<tr><td>Steel core</td><td>Over 6 and less than 175</td></tr>
<tr><td rowspan="2">Streamlined</td><td>Fibre core</td><td>Over 6 and less than 32</td></tr>
<tr><td>Steel core</td><td>Over 6 and less than 30</td></tr>
<tr><td colspan="2" rowspan="2">Non-twisting tope slings</td><td>Fibre core</td><td>Over 6 and less than 36</td></tr>
<tr><td>Steel core</td><td>Over 6 and less than 32</td></tr>
<tr><td colspan="2" rowspan="2">Eared rope slings</td><td>Fibre core</td><td>Over 6 and less than 36</td></tr>
<tr><td>Steel core</td><td>Over 6 and less than 32</td></tr>
<tr><td colspan="2" rowspan="2">Endless rope slings</td><td>Fibre core</td><td>Over 6 and less than 130</td></tr>
<tr><td>Steel core</td><td>Over 6 and less than 125</td></tr>
</table>

<table>
<tr><th colspan="2">Endless rope slings — Minimum manufacturing length</th></tr>
<tr><th>Rope diameter range mm</th><th>Rope multiple</th></tr>
<tr><td>Less than 20</td><td>50</td></tr>
<tr><td>over 20 and less than 40</td><td>60</td></tr>
<tr><td>over 40</td><td>80</td></tr>
</table>

●Please provide the following information when placing your order.

①**Kind of rope**

(1) Rope construction

(2) Kind of lay (in the case of a non-torsion rope ring whether or not the S lay and the Z lay should be used together)

(3) Rope diameter

(4) By kind (G grade or A grade or B grade)

(5) Whether coating is required or not (naked or galvanized)

②**Kind of product**

(1) Ordinary rope slings

(2) Non-torsion rope slings

(3) Eared rope slings

(4) Endless rope slings

(5) Others (specify with a drawing)

③**Kind of clamp (in the case of ordinary rope slings)**

(1) Cylindrical (item normally used)

(2) Streamlined

④**Type of eye part for both ends (in the case of ordinary rope slings and non-torsion rope slings**

(1) No Thimble/slings on both ends ... 2 L type

(2) Thimble/slings on both ends ... 2 T type

(3) Thimble/slings on one end ... LT type

(4) Others (specify with a drawing or make clear on the order sheet)

⑤**Dimensions**

(1) In the case of ordinary rope slings and a non-torsion rope slings

Specify the A dimension (total length) of Fig. 1 or Fig. 2, the B dimension (major axis of the eye) and the C dimension (minor axis of the eye)

Fig. 1●Ordinary rope slings

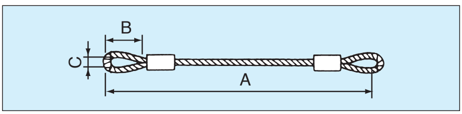
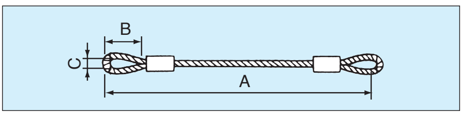


Fig. 2●Non-torsion rope slings



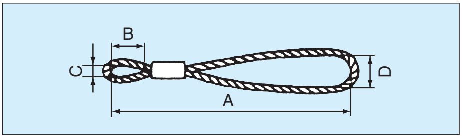
If there is no specification as concerns the C dimension, the O dimension will be made.

(2) In the case of eared rope slings

Specify the A, B, C and D dimension of Fig. 3.

If there are no specification as concerns the C dimension and the D dimension, the 0 dimension will be made.

Fig. 3●Eared rope slings



(3) In the case of endless rope slings

Specify the inner circumference length of Fig. 4.

Moreover, depending on the kind of core and the rope diameter, the shape will be as shown in Table 2.

Fig. 4●Endless rope slings

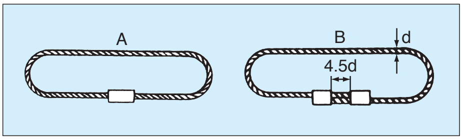


Table 2●Endless rope slings

Kind of core	Rope diameter mm	Shape
With fibre core	Less than 40	Fig. 4 A
	Items exceeding 40	Fig. 4 B
With steel core	Under 38	Fig. 4 A
	Items exceeding 38	Fig. 4 B

⑥**Others**

Please consult this company if a TOYO-LOK other than an aluminum alloy heterogenous tube, such as a heterogenous steel tube is desired.

② SINGLE-LOCK (Swage Socket)

The SINGLE-LOCK is the product name of a rope product of this company whose ends are swage processed.

In the past, compression prevention (TOYO-LOK), socket stopper and eye splice, among others, were mainly used in processing the rope ends. However, of late, the swaging processing is starting to be used, considering the reliability such as the processing strength.

To meet this demand, the SINGLE-LOCK which has the following characteristics was developed by this company.

■ Characteristics

(a)The rope can be locked completely

As the rope is cold worked, the building efficiency is 100% and the rope is not harmed.

(b)Lightweight and easy to use

An epochal lightweight rope has been designed which is easy to attach to all kinds of equipment and machines.

(c)Accurate length

Errors in length is small and the dimensions are accurate.

(d)Also applicable for machine parts

As the rope can be adapted to various kinds of fasteners, as desired, it has various kinds of uses as a machine part.

■ Main Uses

●Various kinds of construction and industrial equipment

Earth drill winch use rope, rock shovel impact absorbing rope, truck crane pendant rope, compact movable crane winch rope, loading arm for oil hauling equipment, ropes for car park lifts and ropes for nuclear furnace elevators.

●Suspension bridges

Suspension rope, fixing rope, wind resisting rope, wind resisting stay rope, hand railing rope, etc.

●Suspended structures

Main rope, guard rope, suspension rope, etc.

●Sea wall pile supports

Main rope (utility model No. 862105)

Specifications

(a)As standard types, there are the eye end, the fork end, the screw end and the flat end.

Other shape metal fittings can also be made, on request.

(b)The standard material uses is the SCM415 (JIS G 4053) but the stainless steel SUS304 (JIS G 4303) can also be made, on request.

(c)The standard rope used all have a steel core but fibre core ropes can be provided, on request.

●When ordering, please specify the following items

(1)Kind of rope (construction, lay method, diameter, kind required, whether coating is required or not)

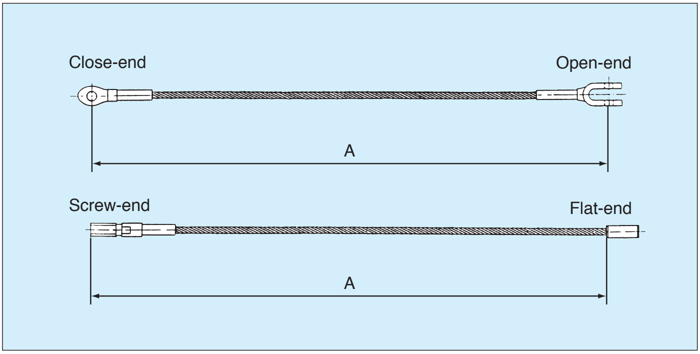
(2)Kind of product

Shape of both ends

(3)Dimensions

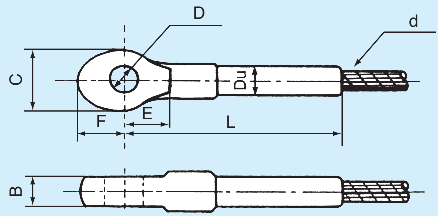
The A dimensions shown in Fig. 5

Fig. 5●Examples of SINGLE-LOCK dimensions



Standard Dimensions

●Swage Socket with Eye End



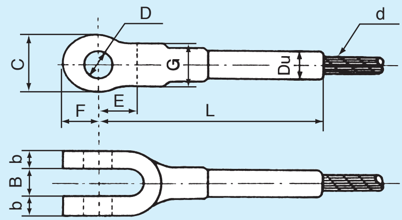
Unit mm

Diameter of applicable rope d	B	C	D	Du	E	F	L (reference dimension)
6(6.3)	10	24	13	10	23	13	82
8	12	28	16	12	27	17	98
9	14	31	18	14	28	18	104
10	15	34	19	16	30	20	112
11.2	17	37	21	18	32	22	122
12	18	41	23	20	34	24	130
12.5	19	42	24	20	35	25	134
14	21	46	26	22	38	28	148
16	24	52	29	26	41	31	165
18	27	58	33	28	44	34	183
20	30	64	36	32	48	38	201
22(22.4)	34	72	41	34	52	42	220
24	36	76	43	38	55	45	237
25	38	79	45	38	57	47	246
26	39	81	46	40	58	48	254
28	42	89	50	44	62	52	272
30	45	94	53.5	46	66	56	291
31.5(32)	48	101	57.5	50	74	59	313
33.5(34)	51	106	60.5	52	78	63	328
35.5(36)	54	113	64.5	56	82	67	349
37.5(38)	57	118	67.5	58	85	70	367
40	60	125	71.5	62	89	74	385
42(42.5)	64	131	75.5	66	92	77	403
44	66	137	78.5	68	96	81	421
45	68	141	80.5	70	98	83	430
46	69	142	81.5	72	99	84	438
47.5(48)	72	150	85.5	74	104	89	457
50	75	155	88.5	78	107	92	475

(Remarks) Diameters in parenthesis ( ) are common to both.

Standard Dimensions

●Swage Socket with Fork End



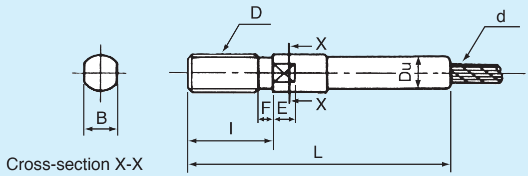
Unit mm

Diameter of applicable rope d	B	b	C	D	Du	E	F	G	L (reference dimension)
6(6.3)	10.5	5	24	13	10	24	13	16	94
8	14	6	28	16	12	28	17	18	105
9	16	7	31	18	14	30	18	20	111
10	17	8	34	19	16	39	20	23	129
11.2	19	9	37	21	18	42	22	26	141
12	20	9	41	23	20	44	24	28	149
12.5	21	10	42	24	20	46	25	28	155
14	23	11	46	26	22	50	28	31	171
16	26	12	52	29	26	54	31	37	188
18	29	14	58	33	28	59	34	40	212
20	32	15	64	36	32	64	38	45	232
22(22.4)	36	17	72	41	34	70	42	49	255
24	38	18	76	43	38	74	45	54	274
25	40	19	79	45	38	77	47	55	285
26	41	20	81	46	40	79	48	56	295
28	44	21	89	50	44	84	52	62	315
30	47	23	94	53.5	46	90	56	65	338
31.5(32)	50	24	101	57.5	50	99	59	70	362
33.5(34)	53	26	106	60.5	52	105	63	74	384
35.5(36)	56	27	113	64.5	56	110	67	79	404
37.5(38)	60	29	118	67.5	58	115	70	83	426
40	63	30	125	71.5	62	121	74	87	447
42(42.5)	67	32	131	75.5	66	126	77	93	472
44	69	33	137	78.5	68	131	81	96	489
45	71	34	141	80.5	70	134	83	99	500
46	72	35	142	81.5	72	135	84	101	509
47.5(48)	75	36	150	85.5	74	142	89	105	531
50	78	38	155	88.5	78	146	92	110	552

(Remarks) Diameters in parenthesis ( ) are common to both.

Standard Dimensions

● **Swage Socket with Screw End**



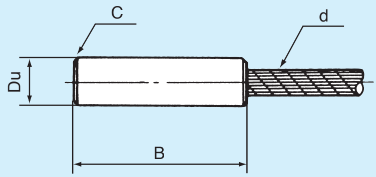
Unit mm

Diameter of applicable rope d	B	D	Du	E	F	I	L (reference dimension)
6(6.3)	9	M12×1.75	10	7	6	39	99
8	12	M14×2	12	8	7	39	114
9	14	M16×2	14	10	8	45	129
10	14	M16×2	16	10	8	45	137
11.2	17	M18×2.5	18	11	9	50	151
12	19	M20×2.5	20	12	10	56	164
12.5	19	M20×2.5	20	12	10	56	167
14	22	M22×2.5	22	13	11	62	185
16	24	M27×3	26	16	14	76	216
18	24	M27×3	28	16	14	76	231
20	30	M33×3.5	32	20	17	92	265
22	30	M33×3.5	34	20	17	92	279
22.4	32	M36×4	34	22	18	101	293
24	32	M36×4	38	22	18	101	305
25	36	M39×4	38	23	20	109	321
26	36	M39×4	40	23	20	109	328
28	41	M45×4.5	44	27	23	126	363
30	41	M45×4.5	46	27	23	126	378
31.5	46	M48×5	48	29	24	134	398
32	46	M48×5	50	29	24	134	402
33.5	50	M52×5	52	31	26	146	427
34	50	M52×5	52	31	26	146	430
35.5	55	M56×5.5	54	34	28	157	455
36	55	M56×5.5	56	34	28	157	458
37.5	55	M56×5.5	58	34	28	157	469
38	55	M56×5.5	58	34	28	157	473
40	55	M60×5.5	62	36	30	168	500
42	60	M64×6	66	38	32	179	527
42.5	60	M64×6	66	38	32	179	531
44	65	M68×6	68	41	34	190	556
45	65	M68×6	70	41	34	190	563
46	65	M68×6	70	41	34	190	570
47.5	65	M68×6	70	41	34	190	581
48	65	M68×6	72	41	34	190	584
50	70	M72×6	78	43	36	202	613

(Remarks) The figures shown in column I are subject to change.

Standard Dimensions

●Swage Socket with Flat End



Unit mm

Diameter of applicable rope d	B	C	Du
8	48	1	18
9	54	1	20
10	60	1	20
11.2	67	1	22
12	72	1	24
12.5	75	1	26
14	84	1	28
16	96	1	32
18	108	1.5	36
20	120	1.5	40
22	132	1.5	42
22.4	134	1.5	44
24	144	1.5	48
25	150	1.5	48
26	156	2	52
28	168	2	54
30	180	2	58
31.5	189	2	60
32	192	2	62
33.5	201	2	64
34	204	2	66
35.5	213	2	68
36	216	2	68
37.5	225	2	70
38	228	2	72
40	240	2	76
42	252	2.5	80
42.5	255	2.5	80
44	264	2.5	84
45	270	2.5	86
46	276	2.5	86
47.5	285	2.5	88
48	288	2.5	88
50	300	2.5	92

③ Socket Processing

There are various methods for processing the ends of the rope but for ropes that have important uses and those that are used for a long period, at a certain place, there is the socket processing method which is the most safe and accurate.

In this method, a melted alloy is poured into the rope end socket and the rope and the socket made one.

This company with its many years of experience and high technologies is receiving wide trust for its processing method of using melted metals, a method that has become firmly established.

● At the time of ordering, please specify the following.

(1) The workplace (in the case of local work)
(2) Time of work (in the case of local work)
(3) Purpose of using the rope
(4) Kind of rope required (construction, diameter, kind, whether coating required or not)
(5) Shape of socket, dimensions

If there is no specification, the TSK socket (see Page 92) of this company will be used.

①TSK Socket

Conventional socket were standardized as ship use wire sockets (JIS F 3432) but the uses and target ropes were limited. To this, the TSK sockets of this company, while having clear uses, has an assured strength and an epochal light weight. (See Table 1)

Table 1●Comparison of the unit mass of the ship use wire socket and the TSK socket

Socket		Ship use wire socket O type kg	TSK socket O shape (standard type) kg
Target rope		6×19galvanized	Strand rope
Applicable rope diameter mm	20	2.1	1.5
	40	18.0	11.0
	60	59.4	36.0

TSK Socket Specifications

(1)The kinds of sockets are divided into the standard type and the strong type, according to the breaking force of the rope. There are tow types for each, or the closed socket (C type) and the open socket (O type). The target ropes for the socket type are shown in Table 2.

Table 2●Target topes for the TSK socket type

Type		Target rope
Standard type	O type	Strand rope
	C type	
Strong type	O type	Spiral rope Locked coil rope
	C type	

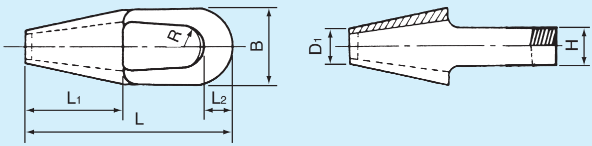
(2)The material used for the socket is more than equal to the S35C (JIS G 4051) and SCMn2A (JIS G 5111).
(3)The material used for the O type pin is more than equal to the S35C (JIS G 4051).
(Note) On request, zinc coated stainless steel sockets can also be made.

Also, on request, specially designed sockets can be made.

Moreover, as concerns NS sockets for bridges, please refer to separate catalog “NS Socket”.

Standard Dimensions

●C Type Socket
Standard Type
(for general ropes)



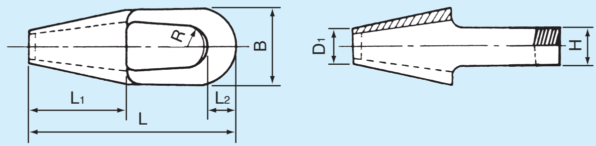
Unit mm

Diameter of applicable rope	L	L1	L2	D1	B	H	R	(Reference) Unit mass kg
20	200	92	28	more than 34	72	30	22	1.7
22	220	102	33	36	82	32	23	2.4
24	240	112	34	40	86	36	26	3.0
26	260	122	37	42	94	38	27	3.9
28	280	132	39	44	100	42	29	4.6
30	298	140	43	48	108	44	31	5.9
32	320	152	45	50	116	48	33	7.2
34	336	158	46	54	120	52	36	8.1
36	358	168	51	56	128	54	37	9.8
38	376	176	52	60	134	58	40	10
40	395	188	57	62	144	58	41	14
42	415	198	58	64	148	62	44	15
44	435	206	63	68	158	64	45	18
46	455	216	65	70	162	68	48	20
48	475	228	67	72	170	70	49	23
50	495	236	69	76	178	74	51	26
52	515	244	71	80	184	79	53	29
54	530	252	75	84	192	80	55	33
56	555	264	76	86	196	84	58	36
58	570	274	80	88	206	86	60	40
60	595	282	82	92	212	90	62	45
62	610	292	84	94	218	92	64	48
64	635	306	88	94	226	96	66	54
66	650	312	90	98	232	98	68	58
68	675	322	92	100	238	102	70	63
70	690	330	96	106	246	106	72	70
72	710	342	98	106	252	108	74	75
74	730	352	100	108	258	110	76	80
76	745	360	102	114	266	114	78	88
78	770	370	106	116	272	118	80	96
80	790	380	110	118	282	118	82	104
82	810	390	112	120	288	122	84	112
84	830	400	115	124	294	124	85	120
86	850	410	116	126	302	128	88	129
88	870	420	119	128	308	130	89	137
90	890	430	122	130	314	134	92	146
92	910	440	124	136	322	138	94	158
94	930	448	126	138	328	140	96	166
96	950	460	130	140	336	144	98	179
98	960	466	132	144	342	146	100	188
100	990	478	134	146	348	150	102	200

(Remarks) Diameters other than those shown in this chart can be made on request.

Standard Dimensions

●C Type Socket
Strong Type
(for locked coil and spiral rope)



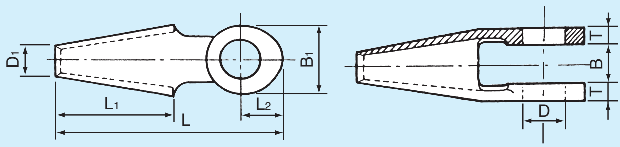
Unit mm

Diameter of applicable rope	L	L1	L2	D1	B	H	R	(Reference) Unit mass kg
20	242	114	34	more than 36	86	34	26	2.9
22	264	126	36	40	94	38	28	3.9
24	292	142	40	42	102	42	30	5.0
26	316	152	42	44	108	46	32	6.1
28	342	164	47	48	118	50	35	8.1
30	362	174	49	54	126	54	37	9.9
32	386	188	53	54	136	56	39	12
34	412	200	56	56	142	60	42	14
36	432	210	58	60	150	64	44	16
38	458	222	61	64	158	68	47	19
40	485	236	65	68	168	70	49	23
42	505	248	69	70	176	72	51	26
44	525	258	71	74	184	76	53	30
46	550	270	74	78	192	80	56	34
48	585	286	77	78	198	84	59	38
50	605	296	79	82	206	88	61	43
52	625	306	84	84	216	90	64	48
54	650	318	86	88	224	94	66	54
56	675	332	90	92	232	98	68	61
58	700	344	91	94	238	102	71	66
60	720	356	95	96	248	106	73	74
62	745	368	98	100	256	110	76	82
64	770	382	102	102	264	112	78	90
66	795	394	106	106	272	116	80	99
68	820	406	107	110	280	120	83	108
70	840	416	111	114	288	124	85	118
72	870	430	112	114	294	128	88	126
74	890	442	117	116	304	130	89	137
76	915	454	120	120	312	134	92	149
78	945	466	123	122	318	138	95	159
80	970	480	127	126	328	140	97	174
82	990	490	129	130	336	144	99	187
84	1020	506	132	132	344	148	102	201
86	1040	516	136	134	352	150	104	215
88	1060	528	138	138	360	154	106	230
90	1090	540	143	142	370	158	109	250
92	1110	554	145	144	378	162	111	265
94	1140	564	148	148	384	166	114	282
96	1160	578	152	148	394	168	116	300
98	1180	590	154	152	402	172	118	319
100	1210	602	158	154	408	176	120	337

(Remarks) Diameters other than those shown in this chart can be made on request.

Standard Dimensions

●O Type Socket Standard Type
(for general ropes)



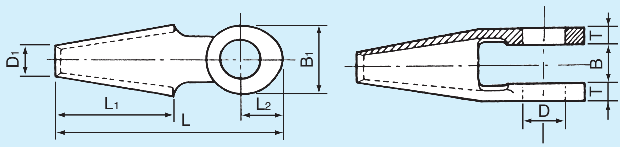
Unit mm

Diameter of applicable rope	L	L_1	L_2	D_1	B_1	B	T	D	(Reference) Unit mass kg
20	190	92	38	more than 34	66	34	16	38	1.5
22	204	102	40	36	72	36	18	41	1.9
24	224	112	44	40	78	40	19	45	2.4
26	244	122	48	42	84	42	21	48	3.2
28	266	132	52	44	90	46	22	52	3.8
30	278	140	54	48	96	48	24	55	4.6
32	300	152	58	50	104	52	26	59	5.8
34	316	158	62	54	110	56	27	63	6.9
36	336	168	66	56	114	58	28	66	7.7
38	356	176	70	60	122	62	30	70	9.4
40	370	188	72	62	128	64	32	73	11
42	390	198	76	64	134	68	33	77	12
44	405	206	78	68	140	70	35	80	14
46	430	216	84	70	146	74	36	84	16
48	445	228	86	72	152	76	38	87	18
50	465	236	90	76	158	80	39	90	20
52	485	244	94	80	166	84	41	94	24
54	495	252	96	84	172	86	43	97	26
56	520	264	100	86	178	90	44	101	29
58	535	274	102	88	184	92	46	105	32
60	555	282	108	92	190	96	47	109	36
62	575	292	110	94	196	98	49	112	39
64	595	306	114	94	202	102	50	116	42
66	610	312	116	98	208	104	52	119	46
68	635	322	122	100	214	108	53	123	51
70	645	330	124	106	222	112	55	127	56
72	670	342	128	106	226	114	56	130	60
74	690	352	132	108	232	116	58	133	65
76	700	360	134	114	240	120	60	137	72
78	720	370	138	116	246	124	61	140	77
80	740	380	142	118	252	126	63	144	82
82	760	390	146	120	258	130	64	147	89
84	780	400	148	124	264	132	66	150	96
86	800	410	152	126	270	136	67	154	102
88	820	420	156	128	276	138	69	157	110
90	840	430	160	130	282	142	70	161	117
92	850	440	162	136	290	146	72	165	126
94	870	448	166	138	296	148	74	168	135
96	890	460	170	140	302	152	75	172	142
98	910	466	172	144	308	154	77	175	153
100	930	478	176	146	314	158	78	179	161

(Remarks) Diameters other than those shown in this chart can be made on request.

Standard Dimensions

●O Type Socket
Strong Type
(for locked coil and spiral rope)



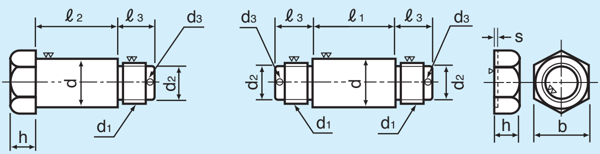
Unit mm

Diameter of applicable rope	L	L1	L2	D1	B1	B	T	D	(Reference) Unit mass kg
20	226	114	44	more than 36	76	38	19	45	2.3
22	248	126	48	40	84	42	21	49	3.2
24	276	142	52	42	92	46	23	53	4.2
26	300	152	58	44	98	50	24	57	5.1
28	322	164	62	48	106	54	26	62	6.5
30	342	174	66	54	114	58	28	66	8.2
32	362	188	68	54	120	60	30	69	9.1
34	390	200	74	56	126	64	31	74	11
36	410	210	78	60	134	68	33	78	13
38	432	222	82	64	142	72	35	82	15
40	455	236	86	68	150	76	37	87	18
42	480	248	90	70	156	78	39	90	21
44	500	258	94	74	164	82	41	94	24
46	520	270	98	78	172	86	43	99	28
48	550	286	104	78	178	90	44	104	31
50	570	296	108	82	186	94	46	108	35
52	590	306	112	84	192	96	48	112	38
54	615	318	116	88	200	100	50	116	43
56	640	332	120	92	208	104	52	120	49
58	660	344	124	94	214	108	53	125	53
60	680	356	128	96	222	112	55	129	59
62	705	368	132	100	230	116	57	133	66
64	730	382	136	102	236	118	59	137	72
66	750	394	140	106	244	122	61	141	80
68	775	406	144	110	252	126	63	145	88
70	795	416	148	114	260	130	65	149	96
72	825	430	154	114	266	134	66	152	103
74	845	442	158	116	272	136	68	157	110
76	865	454	162	120	280	140	70	162	120
78	895	466	168	122	286	144	71	166	129
80	920	480	172	126	294	148	73	170	141
82	930	490	174	130	302	152	75	174	151
84	960	506	178	132	310	156	77	179	163
86	980	516	182	134	316	158	79	182	173
88	1000	528	186	138	324	162	81	186	187
90	1030	540	190	142	332	166	83	191	202
92	1050	554	196	144	338	170	84	195	211
94	1070	564	200	148	346	174	86	199	229
96	1100	578	204	148	352	176	88	203	240
98	1120	590	208	152	360	180	90	207	257
100	1140	602	212	154	366	184	91	211	269

(Remarks) Diameters other than those shown in this chart can be made on request.

Standard Dimensions

●Pin for O Type Socket Standard Type
(general rope use)

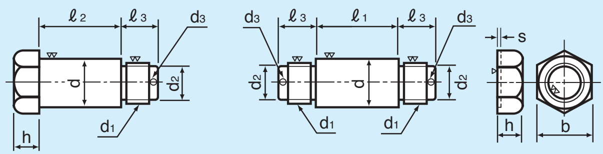


Unit mm

Diameter of applicable rope	d	b	h	ℓ_1	ℓ_2	ℓ_3	d_1	d_2	s	d_3	(Reference) Unit mass kg
20	37.5	50	20	69	68	30	M 33×3.5	26	2	5	1.4
22	40.5	55	21	77	75	33	M 36×4	28	3	6.3	1.8
24	44.5	60	23	83	81	35	M 39×4	31	3	6.3	2.3
26	47.5	65	25	89	87	37	M 42×4.5	33	3	6.3	2.8
28	51	70	27	95	93	39	M 45×4.5	36	3	6.3	3.5
30	54	75	29	101	99	41	M 48×5	38	3	6.3	4.3
32	58	80	31	109	107	47	M 52×5	42	3	8	5.3
34	62	80	31	115	113	47	M 52×5	42	3	8	5.8
36	65	85	34	119	117	50	M 56×5.5	45	3	8	6.8
38	69	90	36	127	125	52	M 60×5.5	49	3	8	8.2
40	72	95	38	134	132	54	M 64×6	52	4	8	9.5
42	76	100	40	140	138	56	M 68×6	56	4	8	11
44	79	100	40	146	144	56	M 68×6	56	4	8	12
46	83	105	42	152	150	62	M 72×6	60	4	10	14
48	86	110	46	158	156	66	M 76×6	64	4	10	16
50	89	115	48	164	162	68	M 80×6	68	4	10	18
52	93	115	48	172	170	68	M 80×6	68	4	10	19
54	96	120	50	178	176	70	M 85×6	73	4	10	21
56	99.5	120	50	184	182	70	M 85×6	73	4	10	22
58	103.5	130	54	190	188	74	M 90×6	78	4	10	26
60	107.5	135	57	196	194	83	M 95×6	83	4	13	30
62	110.5	135	57	202	200	83	M 95×6	83	4	13	32
64	114.5	145	60	208	206	86	M100×6	88	4	13	36
66	117.5	150	63	214	212	89	M105×6	93	4	13	40
68	121.5	150	63	220	218	89	M105×6	93	4	13	42
70	125.5	155	65	228	226	91	M110×6	98	4	13	46
72	128.5	165	69	232	230	95	M115×6	103	4	13	53
74	131.5	165	69	238	236	95	M115×6	103	4	13	54
76	135.5	170	72	246	244	98	M120×6	108	4	13	60
78	138.5	170	72	252	250	98	M120×6	108	4	13	62
80	142.5	180	76	258	256	102	M125×6	113	4	13	70
82	145.5	185	78	264	262	104	M130×6	118	4	13	75
84	148.5	185	78	270	269	104	M130×6	118	4	13	77
86	152.5	195	81	276	274	113	M135×6	123	4	16	87
88	155.5	195	81	282	280	113	M135×6	123	4	16	90
90	159.5	200	84	288	286	116	M140×6	128	4	16	97
92	163.5	210	87	296	294	119	M145×6	133	4	16	108
94	166.5	210	87	302	300	119	M145×6	133	4	16	111
96	170.5	215	90	308	306	122	M150×6	138	4	16	119
98	173.5	220	93	314	312	125	M155×6	143	4	16	128
100	177.5	220	93	320	318	125	M155×6	143	4	16	131

Standard Dimensions

●**Pin for O Type Socket Strong Type**
(for locked coil, spiral rope use)



Unit mm

Diameter of applicable rope	d	b	h	ℓ1	ℓ2	ℓ3	d1	d2	s	d3	(Reference) Unit mass kg
20	44.5	60	23	81	79	35	M 39×4	31	3	6.3	2.3
22	48.5	65	25	89	87	37	M 42×4.5	33	3	6.3	2.9
24	52	70	27	97	95	39	M 45×4.5	36	3	6.3	3.7
26	56	75	29	103	101	41	M 48×5	38	3	6.3	4.5
28	61	80	31	111	109	47	M 52×5	42	3	8	5.7
30	65	85	34	119	117	50	M 56×5.5	45	3	8	6.9
32	68	90	36	125	123	52	M 60×5.5	49	3	8	8.1
34	73	95	38	132	130	54	M 64×6	52	4	8	9.7
36	77	100	40	140	138	56	M 68×6	56	4	8	11
38	81	105	42	148	146	62	M 72×6	60	4	10	13
40	86	110	46	156	154	66	M 76×6	64	4	10	16
42	89	115	48	162	160	68	M 80×6	68	4	10	18
44	93	115	48	170	168	68	M 80×6	68	4	10	19
46	98	120	50	178	176	70	M 85×6	73	4	10	22
48	102.5	130	54	184	182	74	M 90×6	78	4	10	26
50	106.5	135	57	192	190	83	M 95×6	83	4	13	30
52	110.5	135	57	198	196	83	M 95×6	83	4	13	32
54	114.5	145	60	206	204	86	M100×6	88	4	13	37
56	118.5	150	63	214	212	89	M105×6	93	4	13	41
58	123.5	155	65	220	218	91	M110×6	98	4	13	45
60	127.5	155	65	228	226	91	M110×6	98	4	13	48
62	131.5	165	69	236	234	95	M115×6	103	4	13	55
64	135.5	170	72	242	240	98	M120×6	103	4	13	60
66	139.5	180	76	250	248	102	M125×6	113	4	13	68
68	143.5	180	76	258	256	102	M125×6	113	4	13	71
70	147.5	185	78	266	264	104	M130×6	118	4	13	77
72	152.5	195	81	272	270	113	M135×6	123	4	16	88
74	155.5	195	81	278	276	113	M135×6	123	4	16	90
76	160.5	200	84	286	284	116	M140×6	128	4	16	98
78	164.5	210	87	292	290	119	M145×6	133	4	16	109
80	168.5	215	90	300	298	122	M150×6	138	4	16	118
82	172.5	220	93	308	306	125	M155×6	143	4	16	127
84	177.5	220	93	316	314	125	M155×6	143	4	16	132
86	180.5	230	96	322	320	128	M160×6	148	4	16	143
88	184.5	235	99	330	328	131	M165×6	153	4	16	154
90	189.5	245	102	338	336	134	M170×6	158	4	16	169
92	193.5	245	102	344	342	134	M170×6	158	4	16	174
94	197.5	250	105	352	350	137	M175×6	163	4	16	186
96	201	260	108	358	356	140	M180×6	168	4	16	201
98	205	260	108	366	364	140	M180×6	168	4	16	207
100	209	265	111	372	370	151	M185×6	173	4	20	221

Rope Diameter Comparison Chart

mm	in (approx.)	in (approx.)
3	0.118	1/8
4	0.157	5/32
5	0.197	3/16
6	0.236	1/4
7	0.276	9/32
8	0.315	5/16
9	0.354	3/8
10	0.394	13/32
11	0.433	7/16
12	0.472	15/32
13	0.512	1/2
14	0.551	9/16
16	0.630	5/8
17	0.669	11/16
18	0.709	
19	0.748	3/4
20	0.787	
21	0.827	13/16
22	0.866	7/8
23	0.906	29/32
24	0.945	15/16
25	0.984	1
26	1.024	
27	1.063	1 1/16
28	1.102	1 1/8
30	1.181	1 3/16
32	1.260	1 1/4
34	1.339	
35	1.378	1 3/8
36	1.417	
38	1.496	1 1/2
40	1.575	

mm	in (approx.)	in (approx.)
42	1.654	
44	1.732	1 3/4
46	1.811	
48	1.890	1 7/8
50	1.969	2
52	2.047	2 1/16
54	2.126	2 1/8
56	2.205	
58	2.284	2 1/4
60	2.362	2 3/8
62	2.441	2 7/16
64	2.526	2 1/2
65	2.559	2 9/16
66	2.598	2 5/8
68	2.677	2 11/16
70	2.756	2 3/4
72	2.835	2 13/16
74	2.913	2 7/8
76	2.992	3
78	3.071	3 1/16
80	3.150	3 1/8
82	3.228	3 1/4
84	3.307	3 5/16
86	3.386	3 3/8
88	3.465	3 7/16
90	3.543	3 1/2
92	3.622	3 5/8
94	3.701	3 11/16
96	3.780	3 3/4
98	3.858	3 7/8
100	3.937	4

Wire Gage Comparison Chart

S.W.G. British Imperial Standard Wire Gage.
B.W.G. Birmingham Wire Gage.
B.& S. Brown and Sharpe Wire Gage.
AISI S.W.G. American Iron and Steel Institute Steel Wire Gage.
J. de P. Paris Wire Gage.

No.	S.W.G. mm	B.W.G. mm	B.& S. mm	AISI S.W.G. mm	J. de P. mm
000000	11.785	—	14.73	11.220	
00000	10.972	12.700	13.12	10.934	
0000	10.159	11.532	11.68	10.003	
000	9.448	10.795	10.40	9.208	
00	8.839	9.652	9.266	8.407	(PP) 0.40
0	8.229	8.636	8.255	7.785	(P) 0.50
1	7.620	7.620	7.348	7.188	0.60
2	7.010	7.213	6.543	6.668	0.70
3	6.401	6.579	5.827	6.185	0.80
4	5.893	6.045	5.189	5.723	0.90
5	5.385	5.588	4.620	5.258	1.00
6	4.877	5.156	4.115	4.877	1.10
7	4.470	4.572	3.665	4.496	1.20
8	4.064	4.191	3.264	4.115	1.30
9	3.658	3.759	2.906	3.767	1.40
10	3.251	3.404	2.588	3.429	1.50
11	2.946	3.048	2.304	3.061	1.60
12	2.642	2.769	2.052	2.680	1.80
13	2.337	2.413	1.829	2.324	2.00
14	2.032	2.108	1.628	2.032	2.20
15	1.829	1.829	1.450	1.829	2.40
16	1.626	1.651	1.290	1.588	2.70
17	1.422	1.473	1.151	1.372	3.00
18	1.219	1.245	1.024	1.207	3.40
19	1.016	1.067	0.9116	1.041	3.90
20	0.9144	0.886	0.8128	0.884	4.40
21	0.8128	0.8128	0.7239	0.805	4.90
22	0.7112	0.7109	0.6426	0.726	5.40
23	0.6096	0.6347	0.5740	0.655	5.90
24	0.5588	0.5585	0.5105	0.584	6.40
25	0.5080	0.5078	0.4547	0.518	7.00
26	0.4572	0.4570	0.4039	0.460	7.60
27	0.4166	0.4062	0.3607	0.439	8.20
28	0.3759	0.3555	0.3200	0.411	8.80
29	0.3454	0.3300	0.2875	0.381	9.40
30	0.3150	0.3046	0.2540	0.356	10.00
31	0.2946	0.2539	0.2268	0.335	
32	0.2743	0.2286	0.2019	0.325	
33	0.2540	0.2031	0.1798	0.300	
34	0.2337	0.1777	0.1600	0.264	
35	0.2134	0.1269	0.1425	0.241	
36	0.1930	0.1016	0.1270	0.229	
37	0.1727		0.1130	0.216	
38	0.1524		0.1006	0.203	
39	0.1321		0.0897	0.191	
40	0.1219		0.0798	0.178	

SI Units and MSK Weight (former) Unit Conversion Table (units used daily)

Volume	SI unit	former unit
Strength (breaking force)	1N	0.101972 kgf
	9.80665 N	1 kgf
Tension (pull strength) and flexibility coefficient	$1N/mm^2$ [=1MPa=0.1hbar]	$0.101972\ kgf/mm^2$
	$9.80665N/mm^2$	$1kg/mm^2$
Torque	1N・m	0.101972 kgf・m
	9.80665 N・m	1kgf・m
Production volume and amount used	1kg(1t)	1kg(1t)
Unit mass	1kg/m(mass)	1kg/m(weight)
Coating adherence volume	$1g/m^2$	$1g/m^2$
Heat value, job, energy	1J	0.238889cal [$=0.101972\times10^{+1}$kgf・m]
	4.18605J	1cal
	9.80665J	1kgf・m
Plane angle	1rad	57°17′44″8
	0.01744 rad	1°

Conversion Table

(1)Conversion of the thickness

Circumference × 0.3183 = Diameter
Diameter (in) × 25.4 = Diameter (mm)
Diameter × 3.1416 = Circumference
Diameter (mm) × 0.1237 = Circumference (in)
Circumference (in) × 8.0851 = Diameter (mm)
Diameter (mm) × 0.03937 = Diameter (in)

(2)Conversion of unit mass

kg/m × 0.67196 = 1b/ft
1b/ft × 1.4882 = kg/m
Unit mass of 100-meter steel wire = [wire diameter (mm)]^2 × 0.6126(kg)
[the weight shall be set as 7.8]

(3)Conversion of the pull strength

$kgf/mm^2 \times 0.635 = t/in^2$
$kgf/mm^2 \times 1422.3 = 1b/in^2$
$t/in^2 \times 1.5748 = kgf/mm^2$
$1b/in^2 \times 0.0007031 = kgf/mm^2$(100.000 $1b/in^2$ = $70.31kgf/mm^2$)

(4)Conversion of coating adhesion volume

$g/m^2 \times 0.0033$ = oz (ounce)$/ft^2$
$oz/ft^2 \times 305.152 = g/m^2$

Weights and Measures Comparison Table

(1)Comparison table of length

Yard・Pound method				Meter method	
Mile	Yard	Feet	Inch	Meter	Millimeter
2.4403	4,294.9	12,885		3,927.3	
	119.3	357.92		109.09	
	1.988	5.965		1.818	1,818
		0.9942	11.931	0.303	303
1	1,760	5,280		1,609.3	
	1	3	36	0.9144	914.38
		1	12	0.30479	304.79
		0.0833	1	0.0254	25.4
	1.0936	3.281	39.371	1	1,000
			0.0394	0.001	1

One nautical mile = 1,852 meters
One fathom = 6.0 feet = 1.829 meters
One mil = 0.001 inch = 0.0254 millemeters

(3)Area comparison table

Yard・Pound method			Meter method		
Acre	Square feet	Square inch	Are	Square meter	Square Millimeter
2.4507			99.1736		
0.24507			9.9174	991.736	
	35.584			3.30578	
	0.988457	142.34		0.09183	
1	43,560		40.4671	4,046.71	
	1	144		0.0929	
	0.006944	1			645.160
0.0247	1,076.42		1	100	
	10.7642		0.01	1	
		0.00155			1

One hectare = 10,000 square meters
One square mil = 640 acres = 2.58999 square kilometers

(2)Unit mass comparison table

Yard・Pound method			Meter method		
Ton (English)	Pound	Ounce	Ton	Kilogram	Gram
	1.32277	21.1641		0.6	600
0.00369	8.2673	132.277	0.00375	3.75	3,750
		0.13227			3.75
1	2,240	35,840	1.01605	1,016.05	
	1	16		0.4536	453.59
		1			28.349
0.98420	2,204.62		1	1,000	
	2.2046		0.001	1	1,000
		0.03527		0.001	1

One ton (U.S.) (short ton) = 2,000 pounds = 907.185 kilograms

(4)Volume comparison table

Yard・Pound method				Meter method	
Cubic inch	Cubic feet	Gallon (English)	Gallons (U.S.)	Cubic meters	Liters
1,698.2	0.9827	6.1278	7.3514	0.02783	27.8265
	212.26	1,323.6	1,587.9	6.0105	6,010.51
110.04	0.0637	0.3968	0.4765		1.8039
	6.3708	39.676	47.657	0.1804	180.39
1	0.000579				0.01639
1,728	1	6.2290	7.4805	0.0283	28.3168
277.42	0.1606	1	1.2009		4.5459
231.00	0.1337	0.8325	1		3.7854
	35.3147	219.95	264.19	1	1,000
61.024	0.03523	0.2199	0.2642	0.001	1

One bushel (English) = 36.367

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