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Steel wire ropes — Vocabulary, designation and classification

Câbles en acier — Vocabulaire, désignation et classification

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Foreword

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ISO 17893 was prepared by Technical Committee ISO/TC 105, *Steel wire ropes*.

Introduction

This International standard was developed in response to a worldwide demand for a specification covering terms and definitions associated with the design, manufacture and testing of steel wire rope, for a designation system which would provide manufacturers, purchasers and end users with a common method of describing a rope, and for a classification system which would enable ropes of similar construction and mechanical properties to be grouped together.

The designation and classification systems established here can be used for designating and classifying any steel wire rope construction.

Steel wire ropes — Vocabulary, designation and classification

1 Scope

This International Standard defines terms, and specifies a designation system and a classification system, for steel wire ropes.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1 Wires

2.1.1 Outer wires

2.1.1.1
outer wire
⟨spiral rope⟩ wire positioned in the outer layer of a rope

2.1.1.2
outer wire
⟨stranded rope⟩ wire positioned in the outer layer of wires in the outer strands of a rope

2.1.2 Inner wires

2.1.2.1
inner wire
⟨spiral rope⟩ wire of the intermediate layers of a rope positioned between the centre wires and outer layer

2.1.2.2
inner wire
⟨stranded rope⟩ any wire of a rope other than its centre wires, filler wires, core wires or outer wires

2.1.3
filler wire
comparatively small wire used in filler constructions to fill up the interstices between layers of wires

See Figure 8.

2.1.4 Centre wires

2.1.4.1
centre wire
⟨spiral rope⟩ wire positioned at the centre of a rope

2.1.4.2
centre wire
⟨stranded rope⟩ wire positioned at the centre of the strands of a rope

2.1.5
core wire
wire of the core of a stranded rope

2.1.6
load-bearing wire
wire in a rope regarded as contributing towards the breaking force of the rope

2.1.7
layer (of wires)
assembly of wires having one pitch circle diameter, the first layer being that laid immediately over the strand centre

NOTE 1 The exception is the Warrington layer, comprising large and small wires, where the smaller wires are positioned on a pitch circle diameter which is larger than that of the larger wires.

NOTE 2 Filler wires do not constitute a separate layer.

2.1.8
stitching wire
stitching strand
single wire or strand used for the stitching of flat ropes

2.1.9
serving wire
serving strand
single wire or strand used for making a close-wound helical serving to retain the elements of a rope in their assembled position

2.1.10
wire tensile strength grade
R
level of requirement of tensile strength of a wire and its corresponding range, designated by the value according to the lower limit of tensile strength and used when specifying wire and when determining the calculated minimum breaking force or calculated minimum aggregate breaking force of a rope

NOTE It is expressed in newtons per square millimetre.

2.1.11
measured wire tensile strength
R_m
ratio between the maximum force obtained in a tensile test and the nominal cross-sectional area of the test piece

NOTE It is expressed in newtons per square millimetre.

2.1.12
finish and quality of coating
condition of the surface finish of the wire, e.g. bright (uncoated), zinc coated, zinc alloy coated or other protective coating and the class of coating, such as Class B zinc coating, defined by the minimum mass of coating and the adherence of a coating to the steel below

2.1.13
mass of coating
mass of coating (obtained by a prescribed method) per unit of surface area of the uncoated wire

NOTE It is expressed in grams per square metre.

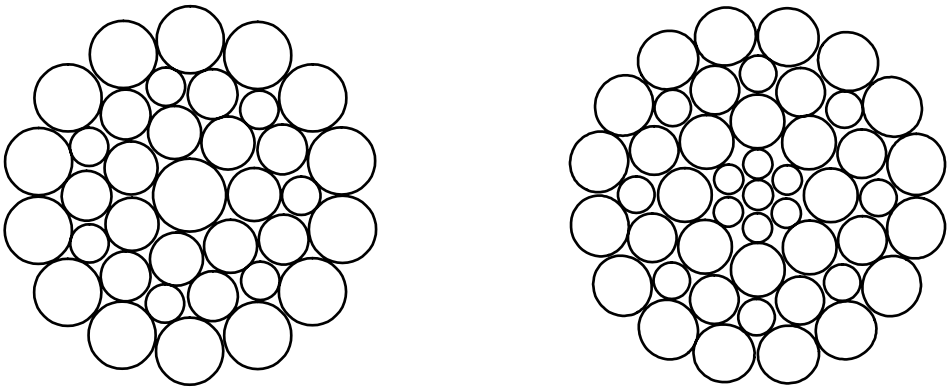
2.2 Strands and strand types

2.2.1
strand
element of rope normally consisting of an assembly of wires of appropriate shape and dimensions laid helically in the same direction in one or more layers around a centre

NOTE Strands containing three or four wires in the first layer, or certain shaped strands (e.g. ribbon), might not have a centre.

2.2.2
round strand
strand with a perpendicular cross-section which is approximately the shape of a circle

See Figure 1.



a) Strand with one centre wire **b) Strand with (1-6) built-up centre**

Figure 1 — Round strand with different centres

2.2.3
triangular strand
V
strand with a perpendicular cross-section which is approximately the shape of a triangle

NOTE Triangular strands can have built-up centres.

See Figure 2.

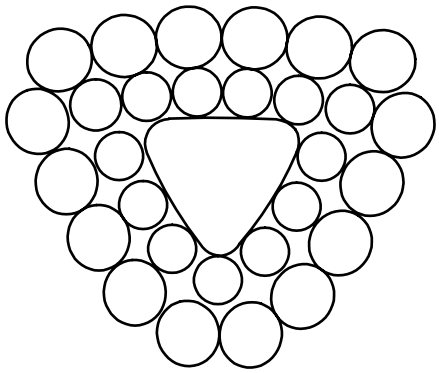


Figure 2 — Triangular strand with triangular (V) centre wire

2.2.4
oval strand
Q
strand having a perpendicular cross-section which is approximately the shape of an oval

See Figure 3.

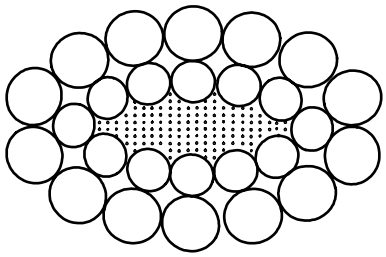


Figure 3 — Oval strand

2.2.5
flat ribbon strand
P
strand without a centre wire, having a perpendicular cross-section which is approximately the shape of a rectangle

See Figure 4.

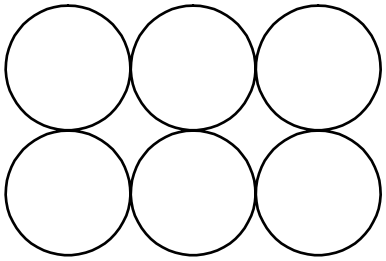


Figure 4 — Flat ribbon strand

2.2.6
single lay strand
strand which contains only one layer of wires

See Figure 5.

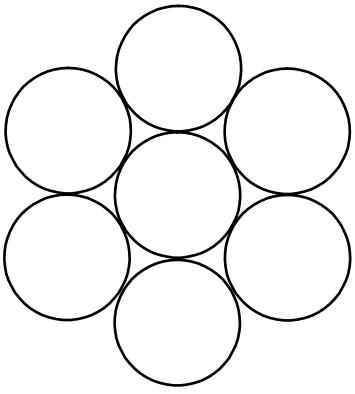


Figure 5 — Single lay strand

2.2.7
parallel lay strand
equal lay
strand which contains at least two layers of wires, all of which are laid in one operation (in the same direction)

NOTE The lay lengths of all the wire layers are equal and the wires of any two superimposed layers are parallel, resulting in linear contact.

2.2.8
Seale
parallel lay strand construction with the same number of wires in both layers

See Figure 6.

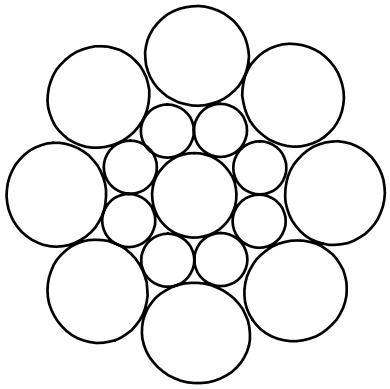


Figure 6 — Seale construction

2.2.9
Warrington
parallel lay strand construction having an outer layer containing alternately large and small wires and twice the number of wires as the inner layer

See Figure 7.

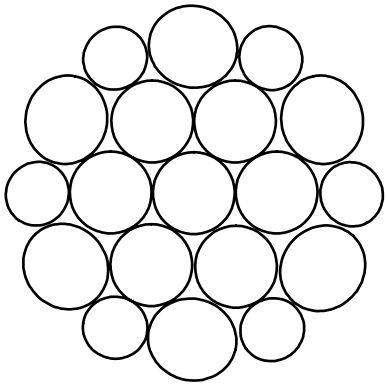


Figure 7 — Warrington construction

2.2.10
filler
parallel lay strand construction having an outer layer containing twice the number of wires than the inner layer, with filler wires laid in the interstices between the layers

See Figure 8.

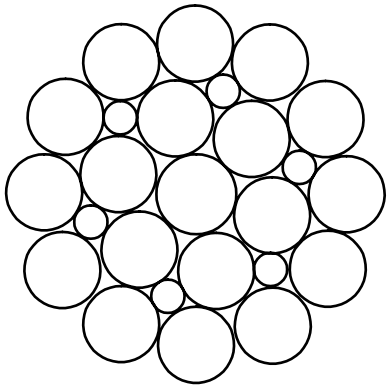


Figure 8 — Filler construction

2.2.11
combined parallel lay
parallel lay strand construction having three or more layers laid in one operation and formed from a combination of strand types **Warrington** (2.2.9) and **Seale** (2.2.8)

See Figure 9.

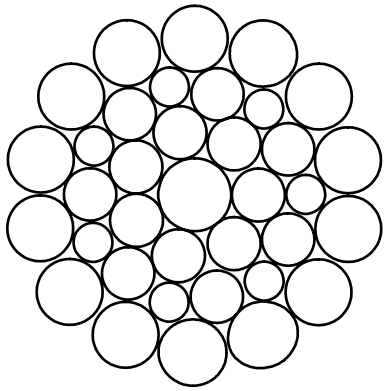


Figure 9 — Example of Warrington-Seale combined parallel lay

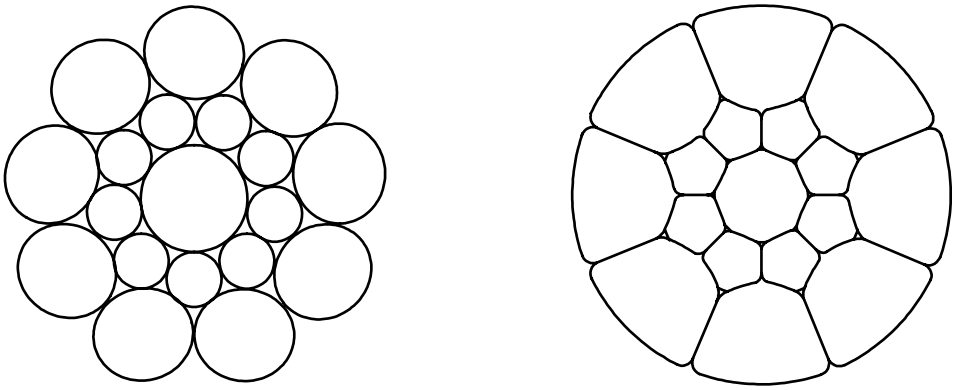
2.2.12
multiple operation lay strand
construction containing at least two layers of wires in which successive layers are laid in more than one operation

2.2.13
cross-lay
M
strand which contains more than one layer of wires, all laid in the same direction, the wires of superimposed wire layers crossing one another and making point contact

2.2.14
compound lay
N
strand which contains a minimum of three layers of wires where the outers layer is laid in a separate operation, but in the same direction as the others, over a parallel lay construction forming the inner layers

2.2.15
compacted strand
K
strand which has been subjected to a compacting process such as drawing, rolling or swaging whereby the metallic cross-sectional area of the wires remains unaltered whereas the shape of the wires and the dimensions of the strand are modified

See Figure 10.



a) Strand before compacting **b) Strand after compacting**

Figure 10 — Compacted round strand

2.3 Cores and core types

2.3.1
core
central element of a round rope around which are laid helically the strands of a stranded rope or the unit ropes of a cable laid rope

2.3.2
fibre core
FC
core made from either natural fibres (NFC) or synthetic fibres (SFC)

NOTE Fibre cores are normally produced in the sequence fibres to yarns, yarns to strands and strands to rope.

2.3.3
steel core
WC
core made from steel wires arranged as a wire strand (WSC) or as an independent wire rope (IWRC)

NOTE 1 The steel core and/or its outer strands can also be covered with either fibre or solid polymer.

NOTE 2 The stranded rope core is normally made as a separate unit, the exception being where the core is closed in parallel with the outer strands, designated PWRC.

2.3.4
solid polymer core
SPC
core consisting of a solid polymer material having a round shape or a round shape with grooves, and which can also contain an internal element of wire(s) or fibre

2.4 Lubricants and preservation agents

2.4.1
rope lubricant
material applied during the manufacture of a strand, core or rope for the purpose of reducing internal friction and/or assisting in providing protection against corrosion

2.4.2
impregnating agent
material used in the manufacture of natural fibre cores, coverings or inserts for the purpose of assisting in inhibiting rotting and decay

2.4.3
preservation agent
material, usually some form of blocking compound, applied during and/or after manufacture of the rope and/or to fibre inserts and coverings for the purpose of assisting in providing protection against corrosion

2.5
Insert
I
fibre or solid polymers so positioned as to separate adjacent strands or wires in the same or overlying layers, or fill the interstices of the rope

2.6 Ropes and rope types

2.6.1 Stranded ropes

2.6.1.1
stranded rope
assembly of several strands laid helically in one (single-layer rope) or more (rotation-resistant or parallel-closed rope) layers around a core or centre

NOTE Stranded ropes consisting of three or four outer strands might, or might not, have a core.

2.6.1.2
single-layer rope
stranded rope consisting of one layer of strands laid helically around a core

See Figure 11.

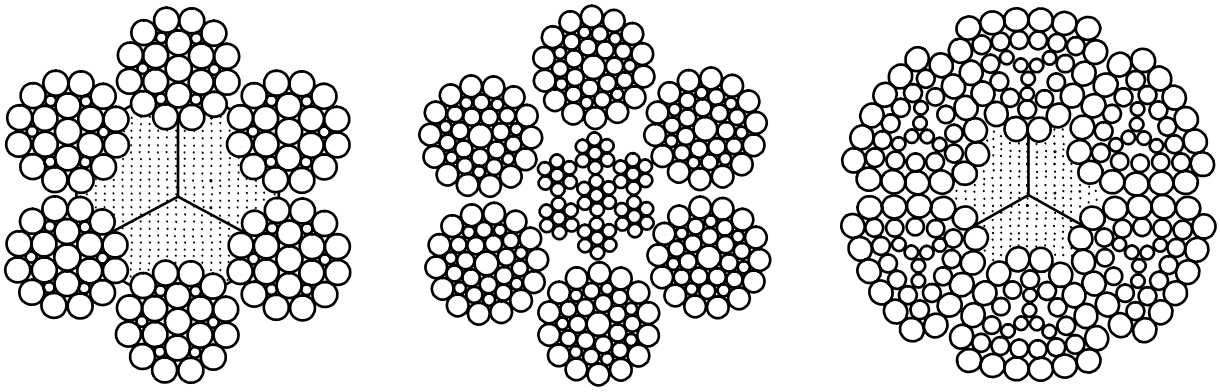


Figure 11 — Examples of single-layer stranded ropes

2.6.1.3
rotation-resistant rope
multi-strand rope (superseded)
non-rotating rope (superseded)
stranded rope designed to generate reduced levels of torque and rotation when loaded

See Figure 12.

NOTE 1 Rotation-resistant ropes generally comprise an assembly of at least two layers of strands laid helically around a centre, the direction of lay of the outer strands being opposite to that of the underlying layer.

NOTE 2 Ropes having three or four strands can also be designed to exhibit rotational-resistant properties.

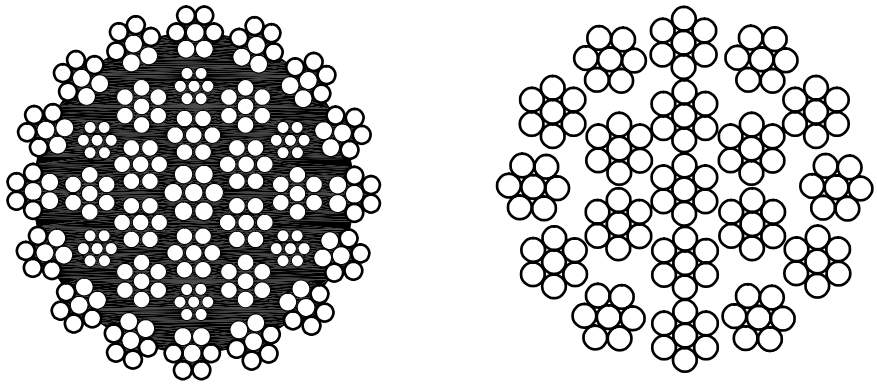


Figure 12 — Examples of rotation-resistant ropes

2.6.1.4
parallel-closed rope
stranded rope consisting of at least two layers of strands laid helically in one closing operation around a strand or fibre centre

See Figure 13.

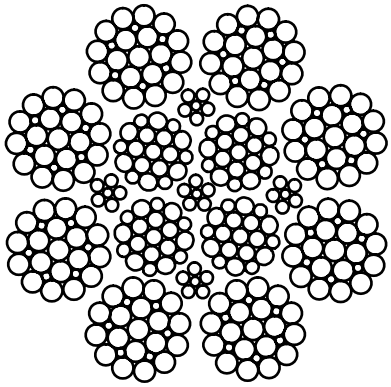


Figure 13 — Example of parallel-closed rope

2.6.1.5
compacted strand rope
stranded rope in which the strands, prior to closing of the rope, are subjected to a compacting process such as drawing, rolling or swaging

2.6.1.6
compacted (swaged) rope
stranded rope which is subjected to a compacting (usually swaging) process after closing the rope, thus reducing its diameter

2.6.1.7
cable-laid rope
assembly of several (usually six) round stranded ropes (referred to as unit ropes) closed helically around a core (usually a seventh rope)

See Figure 14.

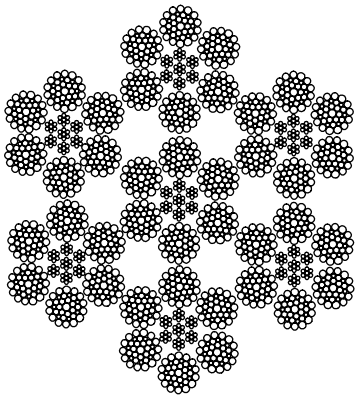


Figure 14 — Example of a cable-laid rope

2.6.1.8
braided rope
assembly of several round strands that are interlaced or plaited together

See Figure 15.

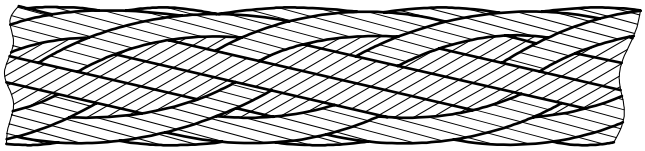


Figure 15 — Example of braided rope

2.6.1.9
electro-mechanical rope
stranded or spiral rope containing electrical conductors

See Figure 16.

2.6.2 Spiral ropes

2.6.2.1
spiral rope
assembly of at least two layers of wires laid helically over a centre round wire, built-up strand or parallel-lay strand, with at least one layer of wires being laid in the opposite direction, i.e. contra-lay, to that of the outer layer(s)

2.6.2.2
spiral strand rope
spiral rope comprising only round wires

See Figure 18.

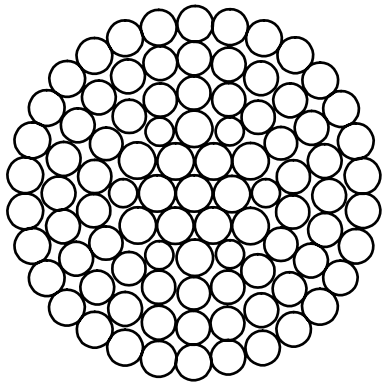


Figure 18 — Example of spiral strand rope

2.6.2.3
half-locked coil rope
spiral rope having an outer layer of half-locked (H-shaped) and round wires

See Figure 19.

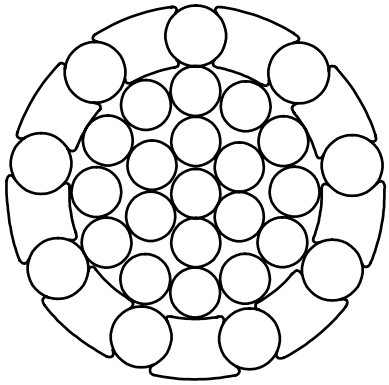


Figure 19 — Example of half-locked coil rope

2.6.2.4
full-locked coil rope
spiral rope having an outer layer of full lock (Z-shaped) wires

See Figure 20.

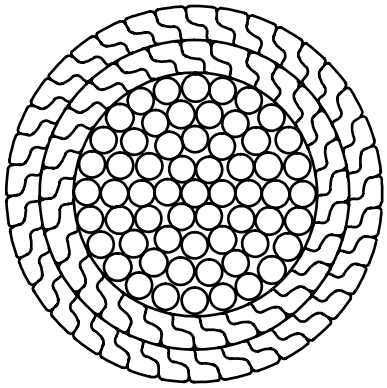


Figure 20 — Example of full-locked coil rope

2.6.3 Ropes with coverings and/or fillings

2.6.3.1
solid polymer-covered rope
rope covered (coated) with a solid polymer

2.6.3.2
solid polymer-filled rope
rope in which the free internal spaces are filled with a solid polymer that extends to, or slightly beyond, the outer circumference of the rope

See Figure 21.

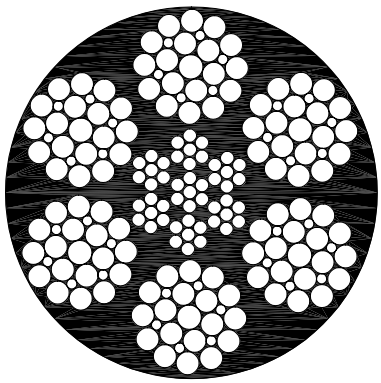


Figure 21 — Solid polymer filled rope

2.6.3.3
solid polymer covered and filled rope
rope which is covered (coated) and filled with a solid polymer

2.6.3.4
cushioned core rope
rope in which the core is covered (coated), or filled and covered (coated), with a solid polymer

See Figure 22.

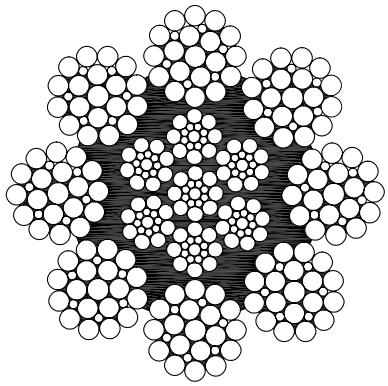


Figure 22 — Cushioned core rope

2.6.3.5
cushioned rope
rope in which the inner layers, inner strands or core strands are covered with solid polymers or fibres to form a cushion between adjacent strands or overlying layers

2.7 Dimensions

2.7.1
dimension of round wire
diameter (δ) of the perpendicular cross-section of the wire

2.7.2
dimension of outer round wire
diameter (δ_a) of the perpendicular cross-section of the outer wire

2.7.3
Shaped wire

2.7.3.1
dimension of shaped wire
⟨full-lock wire⟩ height of the wire

2.7.3.2
dimension of shaped wire
⟨half-lock wire⟩ height and width of the wire

See Figure 23.

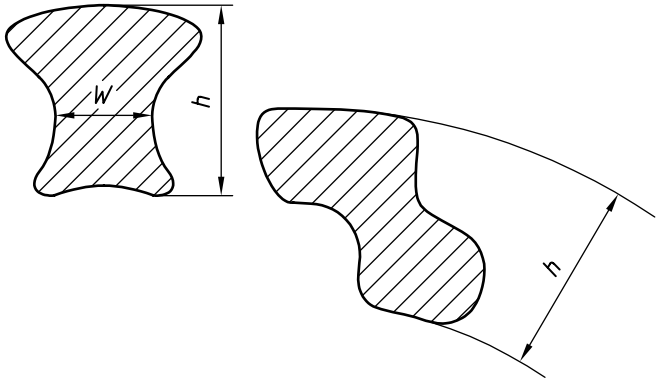


Figure 23 — Half-lock and full-lock wire sections

2.7.4
dimension of round strand
diameter (d_s) of the perpendicular cross-section of the strand

See Figure 24.

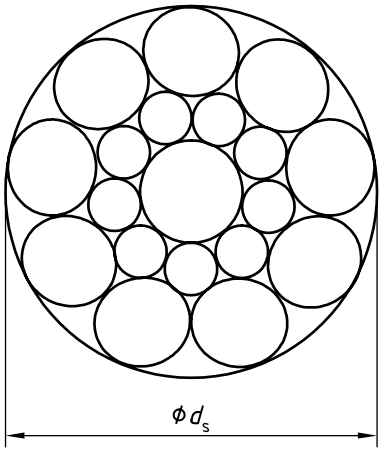
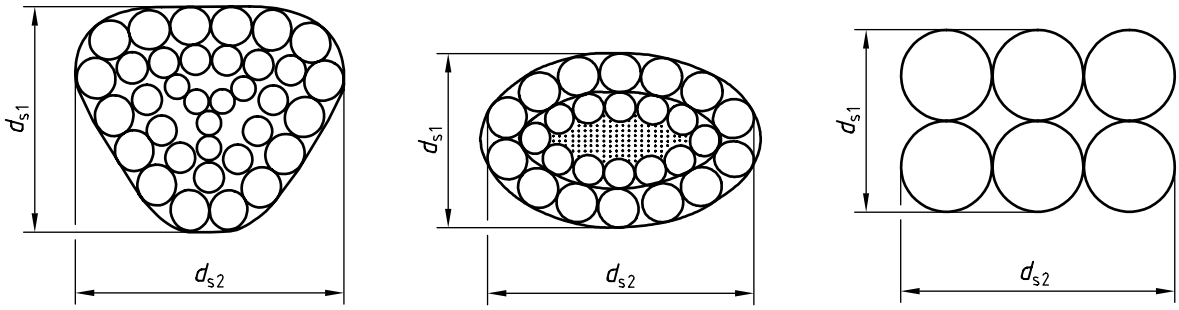


Figure 24 — Dimension of round strand

2.7.5
dimensions of shaped strand
dimension of the height (d_{s1}) and its corresponding perpendicular width (d_{s2})

See Figure 25.



a) Triangular strand **b) Oval strand** **c) Ribbon strand**

Figure 25 — Dimensions of shaped strand

2.7.6
dimension of round rope
diameter which circumscribes the rope cross-section

See Figure 26.

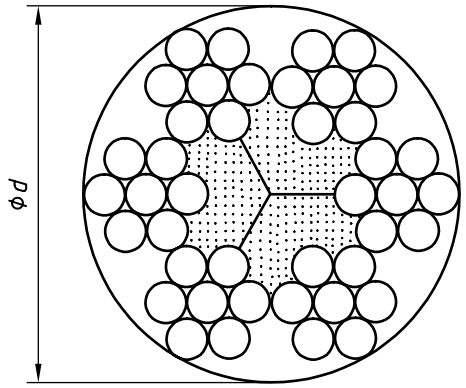


Figure 26 — Dimension of round rope

2.7.7
dimensions of flat rope
width (w) and thickness (s) of the complete cross-section, including stitching or rivets

See Figure 27.

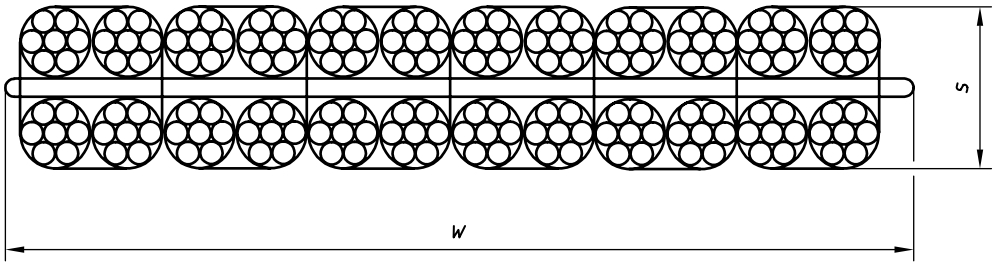


Figure 27 — Dimensions of flat rope

2.7.8
dimensions of covered round rope
diameter which circumscribes the overall rope cross-section, including the cover, followed by the diameter which circumscribes the underlying rope (d)

EXAMPLE 16/13.

2.7.9
dimensions of covered flat rope
width and thickness of the complete cross-section, including the cover, followed by the width (w) and thickness (s) of the underlying cross-section envelope, including stitches or rivets

EXAMPLE $68 \times 24/56 \times 12$.

2.7.10
strand lay length
h
distance parallel to the longitudinal strand axis in which an outer wire makes one complete turn (or helix) about the axis of the strand

See Figure 28.

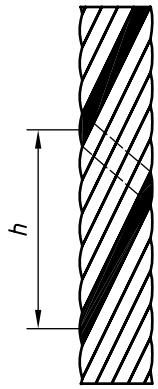


Figure 28 — Lay length — Strand

2.7.11
rope lay length
H
distance parallel to the longitudinal rope axis in which the outer wires of a spiral rope, the outer strands of a stranded rope or the unit ropes of a cable-laid rope make one complete turn (or helix) about the axis of the rope

See Figure 29.

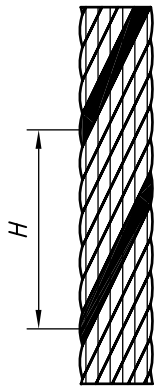


Figure 29 — Lay length — Rope

2.7.12
measured rope length
L_m
length which corresponds to the actual length supplied using a prescribed method

NOTE The measured length can also be specified at a pre-determined load.

2.7.13
nominal rope length
L
length on which the order is usually based

2.7.14
strand clearance
q_s
distance corresponding to the clearance between two adjacent strands in the same strand layer

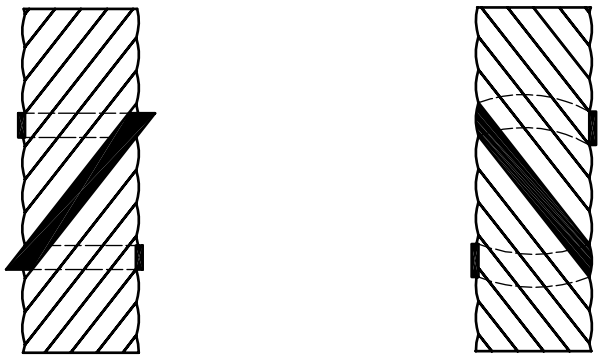
2.7.15
production length
⟨stranded rope⟩ length of finished rope produced from one loading of the closing machine and comprising strands each of which has been produced as one continuous length

2.7.16
production length
⟨spiral rope⟩ length of finished rope produced from one machine loading of outer wires laid over one continuous length of inner rope

2.8 Lay directions and types

2.8.1
lay direction of strand
z, s
direction, right (z) or left (s), corresponding to the direction of lay of the outer wires in relation to the longitudinal axis of the strand

See Figure 30.



a) z (right lay) **b) s (left lay)**

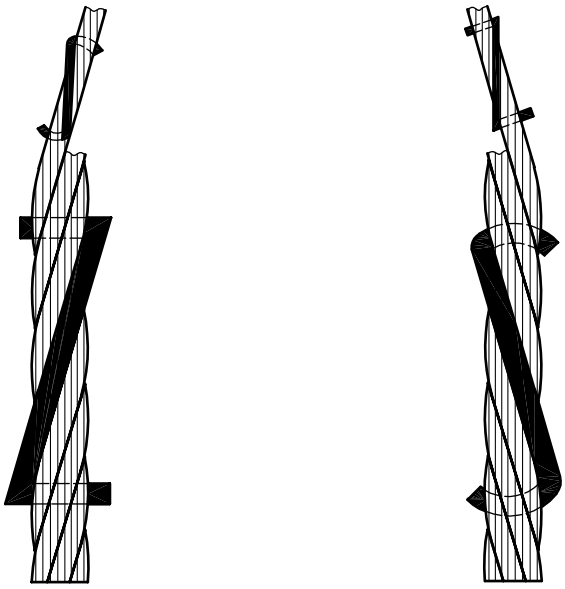
Figure 30 — Lay direction of strands for stranded ropes

2.8.2
lay direction of rope
Z, S
direction, right (Z) or left (S), corresponding to the direction of lay of the outer wires in a spiral rope, the outer strands in a stranded rope or the unit ropes in a cable-laid rope in relation to the longitudinal axis of the rope

2.8.3
ordinary lay
sZ, zS
stranded rope in which the direction of lay of the wires in the outer strands is in the opposite direction to the lay of the outer strands in the rope

See Figure 31.

NOTE The first letter of the symbol denotes strand direction; the second rope direction.



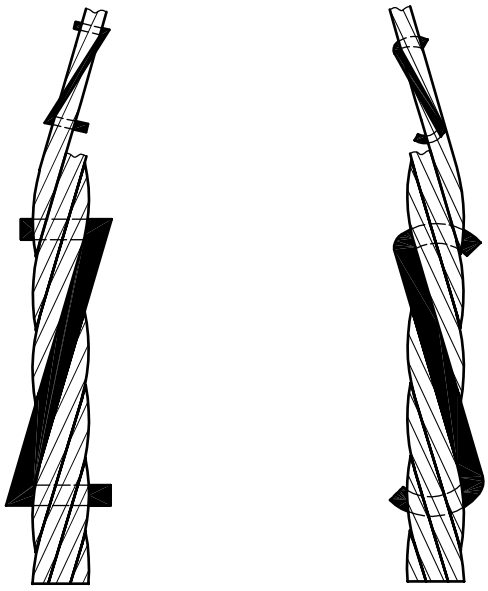
a) Right (sZ) b) Left (zS)

Figure 31 — Ordinary lay

2.8.4
lang lay
zZ, sS
stranded rope in which the direction of lay of the wires in the outer strands is in the same direction as the lay of the outer strands in the rope

See Figure 32.

NOTE The first letter of the symbol denotes strand direction; the second rope direction.



a) Right (zZ) b) Left (sS)

Figure 32 — Lang lay

2.8.5
alternate lay
aZ, aS
stranded rope in which the direction of lay of wires in the outer strands is alternately left and right such that half of the rope is ordinary lay while the other half is lang lay and the lay direction of the rope will be either right (aZ) or left (aS)

2.8.6
contra-lay
:
rope in which at least one layer of wires in a spiral rope or one layer of strands in a stranded rope is laid in the opposite direction to the other layers

NOTE Contra-lay is only possible in spiral ropes having more than one layer of wires and in stranded ropes (e.g. rotation-resistant) having more than one layer of strands.

2.8.7
spring lay
rope containing three steel wire strands laid alternately with three fibre strands

2.9 Values

2.9.1
nominal value
conventional value by which the property is designated

NOTE The symbol does not have a suffix.

2.9.2
minimum value
specified value, associated with a property, below which the measured value is not allowed to fall

NOTE The symbol has an inferior (i.e. subscript) suffix “min”.

2.9.3
calculated value
value obtained by calculation based on given or measured values and on conventional factors

NOTE The symbol has an inferior (i.e. subscript) suffix “c”.

2.9.4
manufacturer's design value
any value (e.g. wire size, lay length, calculated minimum breaking force, spinning loss) which is specified in a rope design

2.9.5
reduced value
value of area or breaking force taking into account the reduction corresponding to the area or strength otherwise contributed by the non-load bearing wires

NOTE The symbol has an inferior (i.e. subscript) suffix “red”.

2.9.6
measured value
value derived by direct measurement in the prescribed manner

NOTE The symbol has an inferior (i.e. subscript) suffix “m”.

2.10 Factors, areas, masses and breaking forces

2.10.1
fill factor
f
ratio between the sum of the nominal metallic cross-sectional areas of all the wires in the rope (A) and the circumscribed area (A_u) of the rope based on its nominal diameter (d)

NOTE This can be expressed as:

$$f = \frac{A}{A_u}$$

2.10.2
nominal metallic cross-sectional area factor
C
factor derived from fill factor and used in the calculation to determine the nominal metallic cross-sectional area of a rope

NOTE This can be expressed as:

$$C = f \cdot \frac{\pi}{4}$$

2.10.3
nominal metallic cross-sectional area
A
product of the nominal metallic cross-sectional area factor (C) and the square of the nominal rope diameter

NOTE This can be expressed as:

$$A = C \cdot d^2$$

2.10.4
calculated metallic cross-sectional area
A_c
design value obtained from the sum of the metallic cross-sectional areas of the wires in the rope based on their nominal diameters:

$$A_c = \frac{\pi}{4} \sum_1^n \delta^2$$

2.10.5
measured metallic cross-sectional area
A_m
sum of the metallic cross-sectional areas of all the wires in the rope based on their measured diameters:

$$A_m = \frac{\pi}{4} \sum_1^n \delta_m^2$$

2.10.6
rope length mass factor
W
factor which takes into account the mass of core and lubricant as well as the metallic elements

2.10.7
nominal rope length mass
M
value derived from the product of the length mass factor and the square of the nominal diameter:

$$M = W \cdot d^2$$

2.10.8
measured rope length mass
M_m
mass of rope, as determined by weighing, expressed in kilograms per 100 m

2.10.9
minimum breaking force factor
K
empirical factor used in the determination of minimum breaking force of a rope and obtained from the product of fill factor (f) for the rope class or construction, spinning loss factor (k) for the rope class or construction and the constant $\pi/4$:

$$K = \frac{\pi f \cdot k}{4}$$

NOTE K factors for the more common rope classes and constructions are given in the respective steel wire rope product standards.

2.10.10
minimum breaking force
F_{min}
specified value, expressed in kilonewtons, below which the measured breaking force (F_m) is not allowed to fall in a prescribed breaking force test and which is normally obtained by calculation from the product of the square of the nominal diameter (d), the rope grade (R_r) and the breaking force factor (K)

$$F_{min} = \frac{d^2 \cdot R_r \cdot K}{1\,000}$$

2.10.11
rope grade
R_r
level of requirement of breaking force which is designated by a number

EXAMPLE 1770, 1960.

NOTE It does not imply that the actual tensile strength grades of the wires in the rope are necessarily of this grade.

2.10.12
calculated minimum breaking force
$F_{c.min}$
value of minimum breaking force based on the nominal wire sizes, wire tensile strength grades and spinning loss factor for the rope class or construction as given in the manufacturer's rope design

2.10.13
measured breaking force
F_m
breaking force obtained using a prescribed method

2.10.14
minimum aggregate breaking force
$F_{e.min}$
specified value, expressed in kilonewtons, below which the measured aggregate breaking force ($F_{e.m}$) is not allowed to fall in a prescribed test and which is normally obtained by calculation from the product of the square of the rope diameter (d), the nominal metallic cross-sectional area factor (C) and the rope grade (R_r):

$$F_{e.min} = \frac{d^2 \cdot C \cdot R_r}{1\,000}$$

2.10.15
calculated minimum aggregate breaking force
$F_{e.c.min}$
value of minimum aggregate breaking force obtained by calculation from the sum of the products of cross-sectional area (based on nominal wire diameter) and tensile strength grade of each wire in the rope, as given in the manufacturer's rope design

2.10.16
reduced minimum aggregate breaking force
$F_{e.red.min}$
specified value below which the measured reduced aggregate breaking force is not allowed to fall and which is obtained by calculation from the sum of the products of cross-sectional area (based on nominal wire diameter) and tensile strength grade of each agreed load bearing wire in the rope

2.10.17
measured aggregate breaking force
$F_{e.m}$
sum of the measured breaking forces of all the individual wires taken from the rope

2.10.18
measured reduced aggregate breaking force
$F_{e.red.m}$
sum of the measured breaking forces of the agreed load bearing wires taken from the rope

2.10.19
calculated measured breaking force
$F_{m.c}$
product of the sum of the measured breaking forces of individual wires after they have been taken out of the rope and the partial spinning loss factor obtained from the results of type testing

2.10.20
calculated measured aggregate breaking force
$F_{e.m.c}$
value obtained by dividing the measured breaking force (F_m) of the rope by the partial spinning loss factor obtained from the results of type testing

2.10.21
measured total spinning loss
difference between the measured aggregate breaking force, before rope making, and the measured breaking force of the rope

2.10.22
measured partial spinning loss
difference between the measured aggregate breaking force ($F_{e.m}$), after rope making, and the measured breaking force of the rope (F_m)

2.10.23
spinning loss factor
k
ratio between either the calculated minimum aggregate breaking force ($F_{e.c.min}$) and the calculated minimum breaking force ($F_{c.min}$) of the rope or the specified minimum aggregate breaking force ($F_{e.min}$) and the specified minimum breaking force (F_{min}) of the rope, as determined from the rope maker's design

2.10.24
measured total spinning loss factor
k_m
ratio between the measured breaking force (F_m) of the rope and the measured aggregate breaking force of the rope, before rope making

2.10.25
measured partial spinning loss factor
$k_{p.m}$
ratio between the measured breaking force (F_m) of the rope and the measured aggregate breaking force of the rope ($F_{e.m}$), after rope fabrication

2.10.26
outer wire diameter factor
a
factor used in the calculation of the approximate diameter of the outer wires of a rope

2.10.27
approximate outer wire diameter
δ_a
the value derived from the product of the outer wire diameter factor and the nominal rope diameter:

$$\delta_a = a \cdot d$$

2.11 Rope characteristics

2.11.1
torque
torsional characteristic determined by test or calculation the value of which is usually expressed in newton metres at a stated tensile loading when both rope ends are prevented from rotating

2.11.2
turn
rotational characteristic determined by test or calculation the value of which is usually expressed in degrees or turns per unit length at a stated tensile loading and determined by test when one end of the rope is free to rotate

2.11.3
fully preformed rope
rope in which the wires in the strands and strands in the rope have their internal stresses reduced, resulting, after removal of any serving, in a rope formation out of which the wires and the strands will not spring

2.12 Rope class and construction

2.12.1
rope class
grouping of ropes of similar mechanical properties and physical characteristics

NOTE For classification details, see Clause 4.

2.12.2
rope construction
detail and arrangement of the various elements of the rope

NOTE For designation details, see Clause 3.

3 Designation

3.1 General

The system for designating steel wire ropes shall be in accordance with 3.2 to 3.4. The system details the minimum amount of information that is required to describe a rope (e.g. when specifying or certifying). The system is capable of accommodating most rope constructions, grades, wire finishes and layers of steel wire ropes. Features a) to f) of 3.2 may also be used for the purposes of rope identification.

3.2 Format

The designation system shall consist of the following (see Figure 33 for examples):

a) dimension(s);

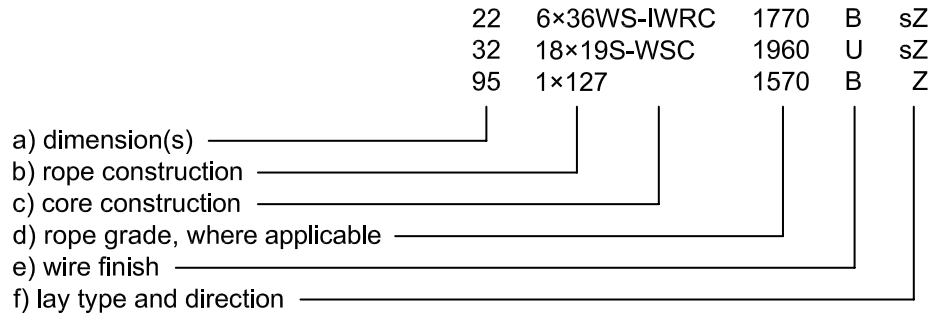
b) rope construction;

c) core construction;

d) rope grade, where applicable;

e) wire finish;

f) lay type and direction.



NOTE The spacing between the features in some of the examples given elsewhere in this International Standard would normally be closed-up in practice.

Figure 33 — Designation system — Examples

3.3 Symbols

3.3.1 Cross-sectional shape of wire, strand and rope

The symbols for cross-sectional shape shall be in accordance with Table 1.

Table 1 — Cross-sectional shape symbols

Cross-sectional shape	Symbol		
	Wire	Strand	Rope
Round	No symbol	No symbol	No symbol
Triangular	V	V	—
Built-up centre[a]	—	B	—
Rectangular	R	—	—
Trapezoidal	T	—	—
Oval	Q	Q	—
Z-shaped	Z	—	—
H-shaped	H	—	—
Flat or ribbon	—	P	—
Compacted[b]	—	K	K
Braided	—	—	BR
Flat			P
single stitching	—	—	PS
double stitching	—	—	PD
riveted	—	—	PN

[a] The symbol B indicates that the strand centre is built-up from a number of wires and succeeds the symbol for strand shape, e.g. a triangular strand of 25 wires with a built-up centre would be designated as V25B.

[b] The symbol K indicates an additional compacting process and precedes the symbol for strand or rope shape and construction, e.g. a compacted round strand of 26 wires Warrington-Seale construction would be designated K26WS.

3.3.2 Types of strand constructions

The symbols for the more common types of round strand constructions shall be in accordance with Table 2.

Table 2 — Symbols for the more common types of round strand constructions

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

[a] N is additional and precedes the basic type symbol, e.g. compound Seale is SN and compound Warrington is WN.

For those strand constructions not covered by Table 2, strand designation shall be in accordance with the number of wires in the strand and the strand shape, examples of which are given in Table 3.

Where the strand designation (using letters) might not be significant enough to accurately reflect the strand construction, the detailed strand construction (using numbers) may be used, starting with the centre wire or strand centre.

Table 3 — Examples of strand designation based on number of wires in the strand

Detailed strand construction	Strand designation
Round strand – parallel lay	
1-6-6F-12-12	37FS
1-7-7F-14-14	43FS
1-7-7-7F-14-14	50SFS
1-8-8F-16-16	49FS
1-6/8-8F-16-16	49FS
1-8-8-8+8-16	49SWS
1-6/8-8-8+8-16	49SWS
1-9-9-9+9-18	55SWS
1-6/9-9F-18-18	55FS
1-9-9-9F-18-18	64SFS
Round strand — compound lay	
1-7-7+7-14/20-20	76WSNS
1-9-9-9+9-18/24-24	103SWSNS
Triangular strand	
V-8	V9
V-9	V10
V-12/12	V25
B-12/12 (built-up centre)	V25B
B-12/15	V28B
Strand with fibre centre (as used in compacted/swaged 3 and 4 strand ropes)	
FC-9/15 (oval strand in centre of 12×P6:3×Q24FC)	Q24FC
FC-12-12 (fibre centre)	24FC
FC-15-15	30FC
FC-9/15-15	39FC
FC-8-8+8-16	40FC
FC-12/15-15	42FC
FC-12/18-18	48FC

3.3.3 Cores, centres of parallel-closed ropes and central elements of rotation-resistant rope

The symbols for cores of single layer ropes, the centres of parallel-closed ropes and the central elements of rotation-resistant ropes shall be in accordance with Table 4.

Table 4 — Symbols for cores, centres of parallel-closed ropes and centres of rotation-resistant ropes

Item or element	Symbol
Single layer rope	
Fibre core	FC
Natural fibre core	NFC
Synthetic fibre core	SFC
Solid polymer core	SPC
Steel core	WC
Wire strand core	WSC
Independent wire rope core	IWRC
Independent wire rope core with compacted strands	IWRC(K)
Independent wire rope core covered with a polymer	EPIWRC
Parallel-closed rope	
Parallel wire rope centre	PWRC
Parallel wire rope centre with compacted strands	PWRC(K)
Parallel wire rope centre filled with a polymer	PWRC(EP)
Rotation-resistant rope	
Central element	
Fibre centre	FC
Wire strand centre	WSC
Compacted wire strand centre	KWSC

3.3.4 Conductors

The symbol for a conductor shall be the letter D and shall precede the designation for the element e.g. DC for the centre of the strand of a stranded rope.

NOTE Conductors may form a wire, strand centre or strand of a stranded rope, a wire or centre wire of a spiral rope, a centre of an electro-mechanical rope, or an insert in a stranded or spiral rope.

3.4 Designation of key features

3.4.1 General

The assembly of the designations of the key features shall be in the sequence of 3.4.2 to 3.4.7.

NOTE In addition, and where applicable, the manufacturer's unique identifier or brand name should also be stated and precede the designation of the rope.

3.4.2 Dimension(s)

For round rope and braided rope, the nominal diameter shall be expressed in millimetres. For flat rope, the nominal dimensions (width x thickness) shall be identified and expressed in millimetres.

For covered ropes, two values will be specified: one for the outer and the other for the inner dimensions. For a round strand rope covered with a solid polymer, the outer diameter is separated from the inner diameter by an oblique stroke (/), e.g. 13,0/11,5.

3.4.3 Construction

3.4.3.1 Stranded ropes

The construction of stranded ropes shall be designated in the following sequences.

a) Single layer rope:

   1) the number of outer strands;

   2) multiplication sign (×);

   3) the number of wires in each of the outer strands and the corresponding strand designation;

   4) connecting symbol dash (-);

   5) the core designation.

   EXAMPLE 6 × 36WS - IWRC. (See Annex B for more examples.)

b) Parallel-closed rope:

   1) the number of outer strands;

   2) multiplication sign (×);

   3) the number of wires in each of the outer strands and the corresponding strand designation;

   4) connecting symbol dash (-);

   5) the designation of the rope centre indicating that it is laid parallel to the outer strands in one closing operation.

   EXAMPLE 8 × 19S - PWRC. (See Annex B for more examples.)

c) Rotation-resistant rope:

   — Ten or more outer strands

      i) either the total number of strands in the rope excluding the central element, or, if the construction of the central element is the same as that of the outer strands, the total number of strands in the rope;

      ii) between parentheses, the designation corresponding to how the inner strands are laid up where there are more than two layers of strands;

      iii) multiplication sign (×);

      iv) the number of wires in each of the outer strands and the corresponding strand designation;

      v) connecting symbol dash (-);

      vi) the designation of the central element.

      EXAMPLE 18 × 7 - WSC or 19 × 7. See Annex B for more examples.

— Eight or nine outer strands[1)]

i) the number of outer strands;

ii) multiplication sign (×);

iii) the number of wires in each of the outer strands and the corresponding strand designation;

iv) connecting symbol colon (:) signifying a contra-lay core;

v) IWRC.

EXAMPLE 8 × 25F: IWRC.

3.4.3.2 Spiral ropes

The construction of spiral ropes shall be designated in the following sequences.

a) Spiral strand:

1) 1;

2) multiplication sign (×);

3) number of wires in the strand.

EXAMPLE 1 × 61.

b) Locked coil rope (according to its application):

1) Half-locked coil:

— HLGR for guide rope;

— HLAR for aerial track rope.

2) Full-locked coil:

— FLAR for aerial track (or carrying) rope;

— FLHR for hoisting rope;

— FLSR for structural rope.

3.4.3.3 Flat ropes

The construction of flat ropes shall be additionally designated as follows:

— HR for hoisting rope;

— CR for compensating (or balance) rope.

---

1) Previously known as “spin-resistant rope”.

3.4.4 Core construction

The core construction shall be designated in accordance with Table 4.

3.4.5 Rope grade

The rope grade, when given, shall identify the level of breaking force of the rope, e.g. 1770, 1370/1770.

NOTE Not all ropes are identified by a rope grade.

3.4.6 Surface finish of wire

The surface finish (of the outer wires) shall be designated using the following letter symbols:

— Bright or uncoated: U

— Zinc coated class B: B

— Zinc coated class A: A

— Zinc alloy coated class B: B(Zn/Al)

— Zinc alloy coated class A: A(Zn/Al)

With other finishes, it will be necessary to ensure that the meaning of any selected letter symbol used is identified.

3.4.7 Type of lay and direction

3.4.7.1 Spiral rope

The direction of lay shall be designated using the following letter symbols:

— Right lay: Z

— Left lay: S

3.4.7.2 Stranded rope

The type and direction of lay shall be designated using the following letter symbols:

— Ordinary lay, right: sZ

— Ordinary lay, left: zS

— Lang lay, right: zZ

— Lang lay, left: sS

— Alternate lay, right: aZ

— Alternate lay, left: aS

NOTE The first letter of the ordinary and Lang types denotes the direction of the wires in the strands and the second letter denotes the direction of the strands in the rope. The second letter of the alternate types denotes the direction of the strands in the rope.

4 Classification

The system for classifying steel wire ropes shall take into account the number of strands, the number of outer strands, the number of layers of strands in the rope and the number of wires, the number of outer wires, the number of layers of wires and strand lay type of the outer strand.

The designation for the class shall be in accordance with Clause 3.

NOTE Tables 5 to 12 give examples of the more common rope classes for each of the basic rope types.

Table 5 — Single layer ropes

Class (excluding core)	Rope			Outer strand			
	Number of strands	Number of outer strands	Number of layers of strands	Number of wires	Number of outer wires	Number of layers of wires	Strand lay type
3 × 7	3	3	1	5-9	4-8	1	Single
3 × 19	3	3	1	15-26	7-12	2-3	Parallel
3 × 36	3	3	1	27-49	12-18	3	Parallel
3 × 19M	3	3	1	12-19	9-12	2	Multi op. cross
3 × 37M	3	3	1	27-37	16-18	3	Multi op. cross
3 × 35N	3	3	1	28-48	12-18	3	Multi op. compound
4 × 7	4	4	1	5-9	4-8	1	Single
4 × 19	4	4	1	15-26	7-12	2-3	Parallel
4 × 36	4	4	1	29-57	12-18	3-4	Parallel
4 × 19M	4	4	1	12-19	9-12	2	Multi op. cross
4 × 37M	4	4	1	27-37	16-18	3	Multi op. cross
4 × 35N	4	4	1	28-48	12-18	3	Multi op. compound
5 × 5	5	5	1	5	4	1	Single
5 × 7	5	5	1	7	6	1	Single
6 × 6	6	6	1	6	6	1	Single
6 × 7	6	6	1	5-9	4-8	1	Single
6 × 12	6	6	1	12	12	1	Single
6 × 19	6	6	1	15-26	7-12	2-3	Parallel
6 × 36	6	6	1	29-57	12-18	3-4	Parallel
6 × 61	6	6	1	61-85	18-24	3-4	Parallel

Table 5 (*continued*)

Class (excluding core)	Rope			Outer strand			
	Number of strands	Number of outer strands	Number of layers of strands	Number of wires	Number of outer wires	Number of layers of wires	Strand lay type
6 × 19M	6	6	1	12-19	9-12	2	Multi op. cross
6 × 24M	6	6	1	24	12-16	2	Multi op. cross
6 × 37M	6	6	1	27-37	16-18	3	Multi op. cross
6 × 61M	6	6	1	45-61	20-24	4	Multi op. cross
6 × 35N	6	6	1	28-48	12-18	3	Multi op. compound
6 × 61N	6	6	1	47-61	20-24	3-4	Multi op. compound
7 × 19	7	7	1	15-26	7-12	2-3	Parallel
7 × 36	7	7	1	29-57	12-18	3-4	Parallel
8 × 7	8	8	1	5-9	4-8	1	Single
8 × 19	8	8	1	15-26	7-12	2-3	Parallel
8 × 36	8	8	1	29-57	12-18	3-4	Parallel
8 × 61	8	8	1	61-85	18-24	3-4	Parallel
8 × 35N	8	8	1	28-48	12-18	3	Multi op. compound
8 × 61N	8	8	1	47-81	20-24	3-4	Multi op. compound
8 × 91N	8	8	1	85-109	24-36	4-6	Multi op. compound
Combined rope							
4 × 6	4	4	1	6	6	1	Single
6 × 6	6	6	1	6	6	1	Single
6 × 12	6	6	1	12	12	1	Single
6 × 24	6	6	1	24	12-15	2	Multi op. cross
Triangular strand rope							
6 × V8	6	6	1	8-9	7-8	1	Single
6 × V25	6	6	1	15-31	9-18	2	Multi op. cross

When the centre wire of a strand is replaced by a centre strand manufactured in a separate stranding operation, e.g. 1-6 (in a round strand) or 3 × 2 + 3F (in a triangular strand), the centre strand may be counted as one wire.

Rope construction 6 × 29F may be classified as either 6 × 19 or 6 × 36.

Rope classes having three or four strands may also be designed and constructed to have resistance to rotation.

Table 6 — Rotation-resistant ropes

Class	Rope			Outer strand			
	Number of strands (excl. centre)	Number of outer strands	Number of layers of strands	Number of wires	Number of outer wires	Number of layers of wires	Strand lay type
Round strand:							
2 operation closing							
18 × 7	17-18	10-12	2	5-9	4-8	1	Single
18 × 19	17-18	10-12	2	15-26	7-12	2-3	Parallel
18 ×36	17-18	10-12	2	29-57	12-18	3-4	Parallel
2 operation closing							
23 × 7	21-27	15-18	2	5-9	4-8	1	Single
23 × 19	21-27	15-18	2	15-26	7-12	2-3	Parallel
2 operation closing							
24 × 7	19-28	11-12	3	5-9	4-8	1	Single
24 × 19	19-28	11-12	3	15-26	7-12	2-3	Parallel
3 operation closing							
34(M) × 7	34-36	17-18	3	5-9	4-8	1	Single
34(M) × 19	34-36	17-18	3	15-26	7-12	2-3	Parallel
34(M) ×36	34-36	17-18	3	29-57	12-18	3-4	Parallel
2 operation closing							
35(W) × 7	27-40	15-18	3	5-9	4-8	1	Single
35(W) × 19	27-40	15-18	3	15-26	7-12	2-3	Parallel
35(W) × 36	27-40	15-18	3	29-57	12-18	3-4	Parallel
8 × 7:IWRC	14 - 16	8	2	5-9	4-8	1	Single
8 × 19:IWRC	14 - 16	8	2	15-26	7-12	2 - 3	Parallel
8 × 36:IWRC	14 -16	8	2	29-57	27-18	3 - 4	Parallel
9 × 7:IWRC	18	9	2	5-9	4-8	1	Single
9 × 19:IWRC	18	9	2	15-26	7-12	2 - 3	Parallel
9 × 36:IWRC	18	9	2	29-57	27-18	3 - 4	Parallel
Shaped strand:							
2 operation closing							
10 × Q10	10-14	6-9	2	8-10	8-10	1	Single
12xP6:Q3x24FC	15	12	2	6	6	1	Single
3 operation closing							
19(M) × Q12	19	8	3	10-12	10-12	1	Single
19(M) × Q26	19	8	3	24-28	14-16	2	Multi op. cross
Rope classes having 3 or 4 strands may also be designed and constructed to have resistance to rotation.							

Table 7 — Parallel-closed ropes

Class	No of strands (excl. centre)	No of outer strands	No of layers of strands	No of wires in outer strands	No of outer wires	No of layer of wires	Strand lay type
6 × 19-PWRC	12	6	2	15-26	7-12	2-3	Parallel
6 × 36-PWRC	12	6	2	29-57	12-18	3-4	Parallel
8 × 7-PWRC	16	8	2	5-9	4-8	1	Single
8 × 19-PWRC	16	8	2	15-26	7-12	2-3	Parallel
8 × 36-PWRC	16	8	2	29-57	12-18	3-4	Parallel
9 × 7-PWRC	18	9	2	5-9	4-8	1	Single
9 × 19-PWRC	18	9	2	15-26	7-12	2-3	Parallel
9 × 36-PWRC	18	9	2	29-57	12-18	3-4	Parallel

Table 8 — Cable-laid ropes

Class (excluding core)	Rope	Unit rope			Outer strand of unit rope			
	Number of unit ropes	Number of strands	Number of outer strands	Number of layers of strands	Number of wires	Number of outer wires	Number of layers of wires	Strand lay type
6 × 6 × 7	6	6	6	1	5-9	4-8	1	Single
6 × 6 × 19	6	6	6	1	15-26	7-12	2-3	Parallel
6 × 6 × 36	6	6	6	1	27-57	12-18	3-4	Parallel
6 × 6 × 61	6	6	6	1	61-73	20-24	3-4	Parallel
6 × 6 × 19M	6	6	6	1	12-19	9-12	2	Multi op. cross
6 × 6 × 37M	6	6	6	1	27-37	16-18	3	Multi op. cross
6 × 6 × 61M	6	6	6	1	45-61	20-24	4	Multi op. cross
6 × 6 × 35N	6	6	6	1	28-48	12-18	3	Multi op. comp.
6 × 6 × 61N	6	6	6	1	47-81	20-24	3-4	Multi op. comp.
6 × 6 × 91N	6	6	6	1	85-109	24-36	4-6	Multi op. comp.
6 × 8 × 19	6	8	8	1	15-26	7-12	2-3	Parallel
6 × 8 × 36	6	8	8	1	27-57	12-18	3-4	Parallel
6 × 8 × 61	6	8	8	1	61-73	20-24	3-4	Parallel
6 × 8 × 35N	6	8	8	1	28-48	12-18	3	Multi op. comp.
6 × 8 × 61N	6	8	8	1	47-81	20-24	3-4	Multi op. comp.
6 × 8 × 91N	6	8	8	1	85-109	24-36	4-6	Multi op. comp.
Spring lay:								
6 × 3 × 19	6	3 [a]	3 [a]	1	15-26	7-12	2-3	Parallel
6 × 3 × 19M	6	3 [a]	3 [a]	1	12-19	9-12	2	Multi op. cross

[a] See 2.8.7.

Table 9 — Flat ropes

Class	Rope	Unit rope		Strand of unit rope			
	Number of unit ropes	Number of strands	Number of layers of strands	Number of wires	Number of outer wires	Number of layers of wires	Strand lay type
P6 × 4 × 7	6	4	1	5-9	4-8	1	Single
P6 × 4 × 12M	6	4	1	12	9	2	Multi op. cross
P8 × 4 × 7	8	4	1	5-9	4-8	1	Single
P8 × 4 × 12M	8	4	1	12	9	2	Multi op. cross
P8 × 4 × 14M	8	4	1	14	10	2	Multi op. cross
P8 × 4 × 19W	8	4	1	7	12	2	Parallel
P8 × 4 × 19M	8	4	1	7	12	2	Multi op. cross

Table 10 — Spiral strand

Class	Number of wires	Number of outer wires	Number of layers of wires
1 × 19	17-37	11-16	2-3
1 × 37	34-59	17-22	3-4
1 × 61	57-85	23-28	4-5
1 × 91	86-114	29-34	5-6
1 × 127	> 114	> 34	> 3

Table 11 — Strand

Class	Number of wires	Number of outer wires	Number of layers of wires	Strand lay type
1 × 7	5-9	4-8	1	Single
1 × 19	15-26	7-12	2-3	Parallel
1 × 19M	12-19	9-12	2	Multi op. cross
1 × 36	27-49	12-18	3	Parallel
1 × 37M	27-37	16-18	3	Multi op. cross

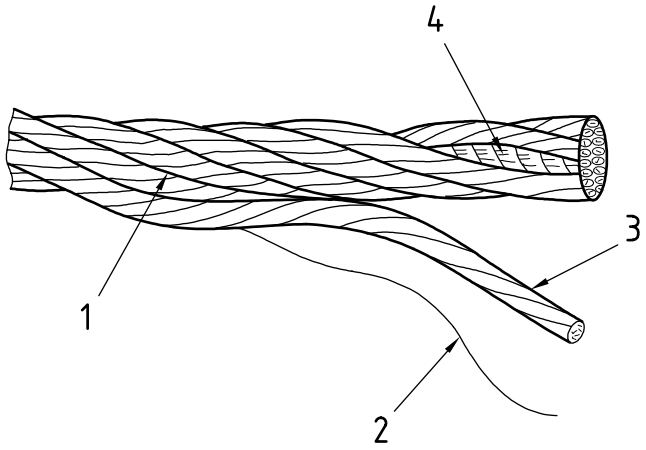
Table 12 — Locked coil

Class	Number of layers of wires
Single layer of half-locked wires	2 or more
Double layer of half-locked wires	4 or more
Multiple layers of half-locked wires	6 or more
Single layer of full-locked wires	2 or more
Double layer of full-locked wires	4 or more
Triple layer of full-locked wires	4 or more
Multiple layer of full-locked wires	8 or more

Annex A
(informative)

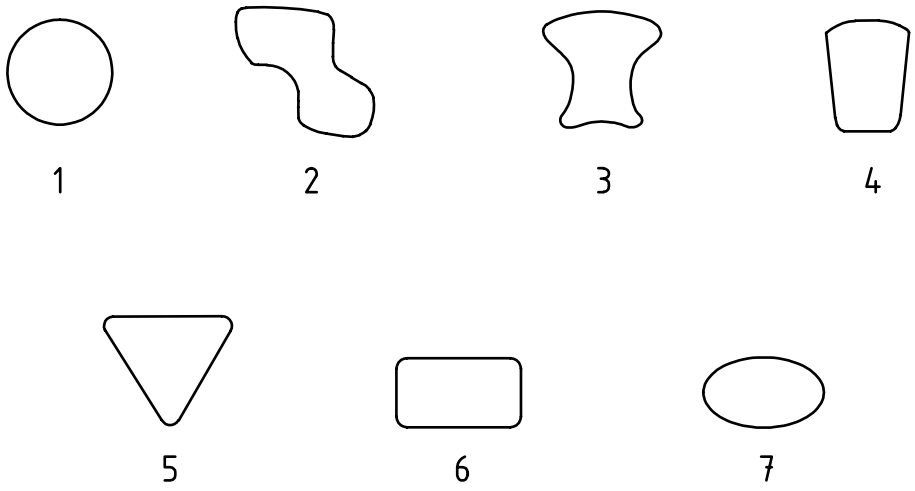
Elements of a rope

See Figures A.1 and A.2.



Key
1 wire rope
2 wire
3 strand
4 core

Figure A.1 — Stranded rope



Key
1 round
2 full-locked (Z)
3 half-locked (H)
4 trapezoidal (T)
5 triangular (V)
6 rectangular (R)
7 oval (Q)

Figure A.2 — Examples of wire shapes

Annex B
(informative)

Designation system

B.1 Strand construction for stranded ropes

See Figure B.1.

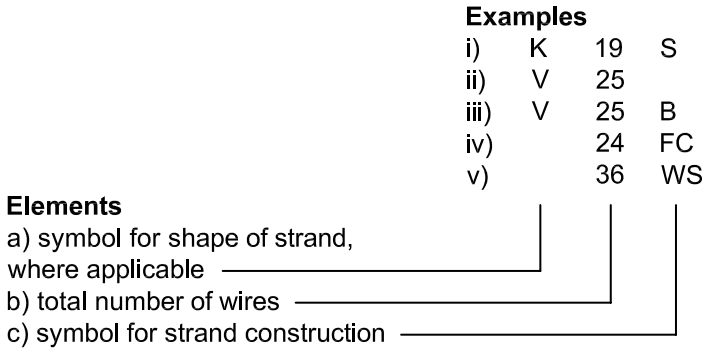


Figure B.1 — Strand construction for stranded ropes — Designation example

B.2 Rope construction

B.2.1 Spiral strand

See Figure B.2.

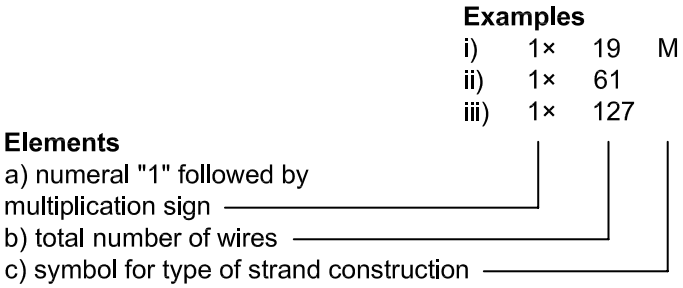


Figure B.2 — Spiral strand — Designation example

B.2.2 Stranded rope

B.2.2.1 Single layer stranded rope

See Figure B.3

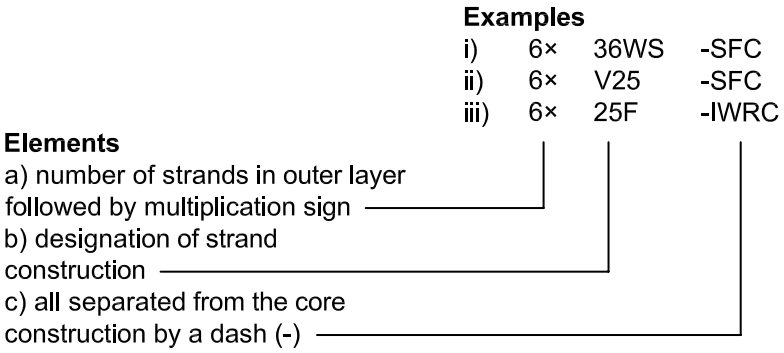


Figure B.3 — Single layer stranded rope — Designation example

B.2.2.2 Rotation-resistant rope

See Figure B.4.

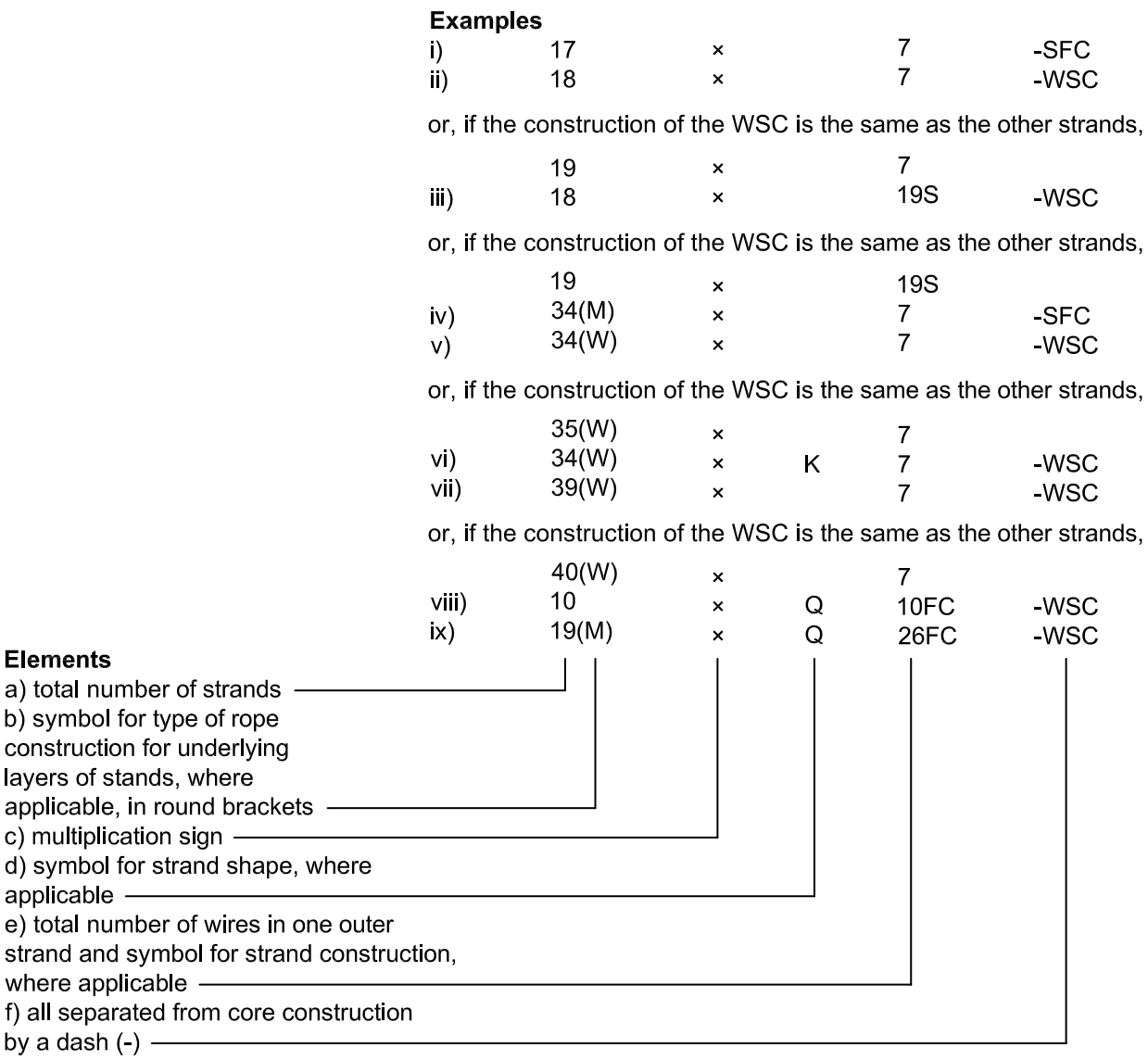


Figure B.4 — Rotation resistant rope — Designation example

B.2.2.3 Parallel-closed rope

See Figure B.5.

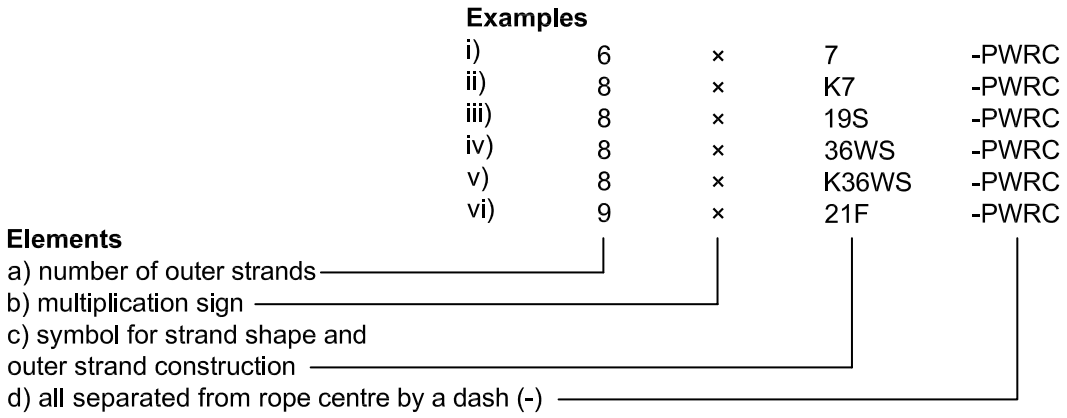


Figure B.5 — Parallel-closed rope — Designation example

B.2.3 Cable-laid rope

See Figure B.6.

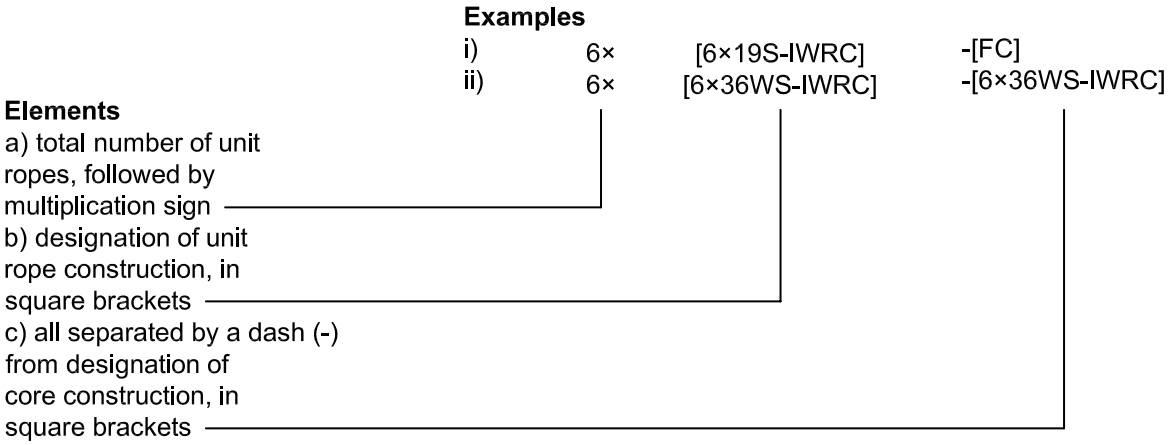


Figure B.6 — Cable-laid rope — Designation example

B.2.4 Braided rope

See Figure B.7.

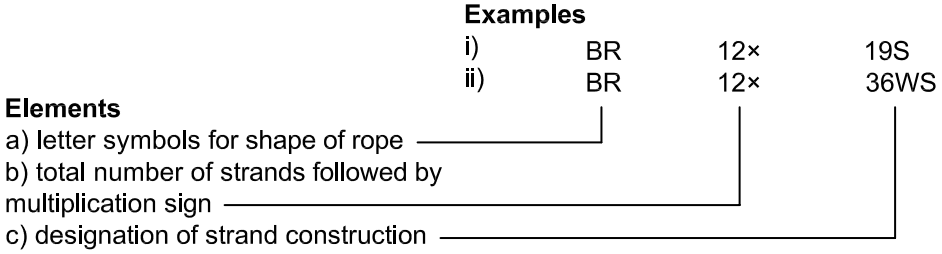


Figure B.7 — Braided rope — Designation example

B.2.5 Flat rope

See Figure B.8.

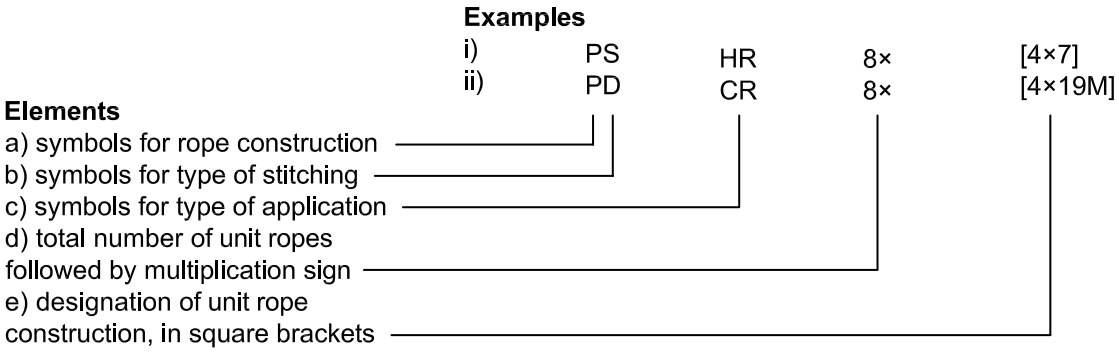


Figure B.8 — Flat rope — Designation example

Alphabetical index

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