AS 3569—2010
(Incorporating Amendment No. 1)

Australian Standard®

Steel wire ropes—Product specification

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- Australasian Institute of Mining and Metallurgy
- Australian Business Limited
- Australian Chamber of Commerce and Industry
- Crane Industry Council of Australia
- Materials Australia
- Shipping Australia
- TestSafe Australia

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Australian Standard®

Steel wire ropes—Product specification

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PREFACE

This Standard was prepared by the Standards Australia Committee ME-007, Steel Wire Ropes to supersede AS 3569—1989.

This Standard incorporates Amendment No. 1 (October 2012). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The objective of this Standard is to provide a common specification, vocabulary, designation and classification system for steel wire ropes for reference by manufacturers, suppliers, users and regulators so that steel wire ropes may be selected and applied appropriately.

Australia has a standard for spiral ropes (AS 2841, *Galvanized steel wire strand*), which does not conflict with this Standard.

This Standard is based on the following ISO Standards:

ISO
2408:2004 Steel wire ropes for general purposes—Minimum requirements

17893:2004 Steel wire ropes—Vocabulary, designation and classification

Variations in this Standard from the above ISO Standards include the following:

1 The range of sizes has been extended beyond 60 mm.

2 Breaking strengths of 1570 Grade ropes have been developed for a limited range of sizes and classifications of wire ropes.

3 The Australian Standards for wire and coatings for wire are specified.

4 The information required on test certificates has been expanded.

5 The markings required are more substantial.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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S E C T I O N 1 S C O P E A N D G E N E R A L

1.1 SCOPE

This Australian Standard specifies minimum requirements for the manufacture and testing of stranded steel wire ropes for general purposes, including lifting equipment such as cranes and hoists. Ropes for slings are also dealt with, and tables giving minimum breaking forces for the more common sizes, grades and constructions of stranded rope presented. It is applicable to single-layer, rotation-resistant and parallel-closed ropes made from wires of uncoated (bright), zinc-coated and zinc-alloy coated finish. Additional requirements may apply for specific applications including, but not limited to the following:

(a) Mining purposes.

(b) Aircraft control.

(c) The petroleum and natural gas industries.

(d) Aerial ropeways and funiculars.

(e) Lifts.

NOTES:

1 For rope grade equivalents see Appendix F.

2 Standards relevant for the application of steel wire ropes are listed in Appendix G.

1.2 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard:

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS	
1394	Round steel wire for ropes
4534	Zinc and zinc/aluminium-alloy coatings on steel wire
ISO	
2408	Steel wire ropes for general purposes—Minimum requirements
3108	Steel wire ropes for general purposes—Determination of actual breaking load
4345	Steel wire ropes—Fibre main cores—Specification
4346	Steel wire ropes for general purposes—Lubricants—Basic requirements
6892	Metallic materials–Tensile testing
6892-1	Part 1: Method of test at room temperature

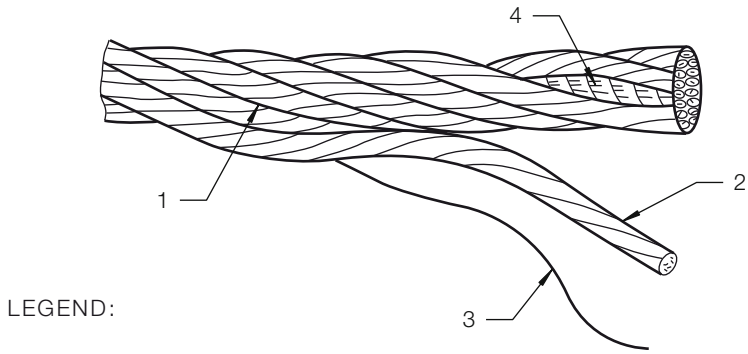
SECTION 2 ELEMENTS OF A ROPE

2.1 DESCRIPTION

2.1.1 General

Figure 1 shows the components of a stranded rope.

The system for describing 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.



LEGEND:

1 = Wire rope
2 = Strand
3 = Wire
4 = Core

FIGURE 1 STRANDED ROPE

2.1.2 Direction and type of lay

The direction and type of rope lay shall be one of the following:

(a) Right ordinary lay (sZ).

NOTE: Formerly referred to as right hand ordinary lay (designated RHOL) and right regular lay (designated RRL).

(b) Left ordinary lay (zS).

NOTE: Formerly referred to as left hand ordinary lay (designated LHOL) and left regular lay (designated LRL).

(c) Right Lang lay (zZ).

NOTE: Formerly referred to as right hand Langs lay (designated RHLL) or right Lang lay (designated RLL).

(d) Left Lang lay (sS).

NOTE: Formerly referred to as left hand Langs lay (designated LHLL) or left Lang lay (designated LLL).

(e) Right alternate lay (aZ).

NOTE: Formerly referred to as right hand alternate lay (designated RHAL).

(f) Left alternate lay (aS).

NOTE: Formerly referred to as left hand alternate lay (designated LHAL).

NOTE:The direction and type of rope lay should be specified by the purchaser.

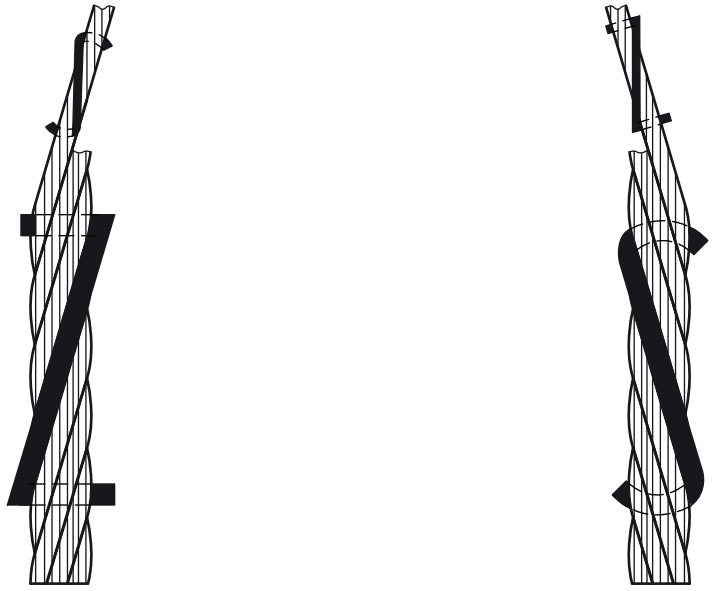
2.1.3 Lay direction of rope—Z, S

2.1.3.1 *General*

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.

2.1.3.2 *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 2.1.3.2).



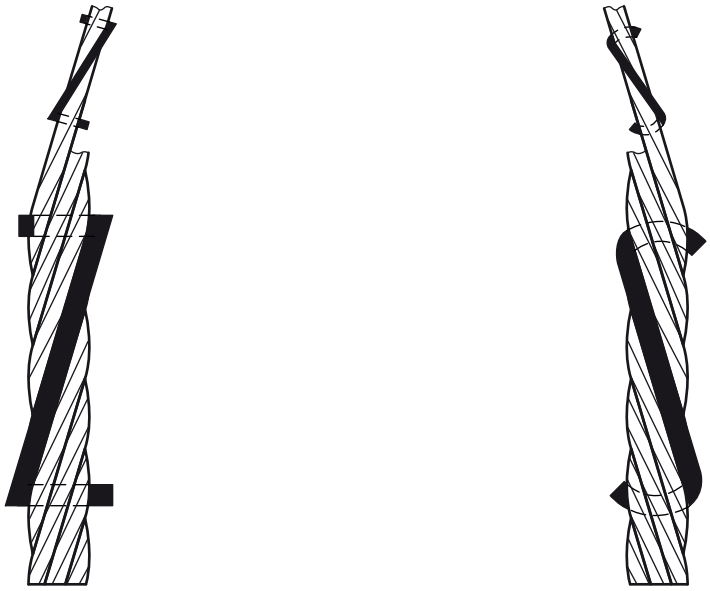
(a) Right (sZ) (b) Left (zS)

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

FIGURE 2.1.3.2 ORDINARY LAY

2.1.3.3 *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 2.1.3.3).



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

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

FIGURE 2.1.3.3 LANG LAY

2.1.3.4 *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).

2.1.3.5 *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.

2.1.4 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 2.1.4).

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

FIGURE 2.1.4 LAY DIRECTION OF STRANDS FOR STRANDED ROPES

2.2 DIMENSIONS

2.2.1 Diameter

2.2.1.1 *General*

The nominal diameter (*d*) shall be the dimension by which the rope is designated.

2.2.1.2 *Dimension of round rope*

Diameter that circumscribes the rope cross-section (see Figure 2.2.1.2).

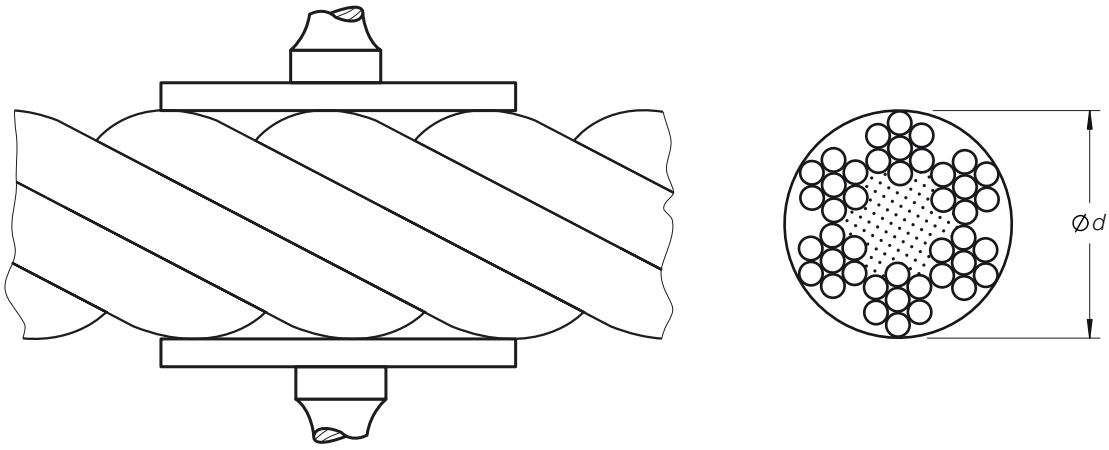


FIGURE 2.2.1.2 DIMENSION OF A ROUND ROPE

2.2.1.3 *Dimension(s)*

For round rope and braided rope, the nominal diameter shall be expressed in millimetres.

2.2.1.4 *Diameter measurement*

Diameter measurements shall be taken on a straight portion of rope, either under no tension or a tension not exceeding 5% of the minimum breaking force, at two positions spaced at least 1 m apart. At each position, two measurements, at 90° apart, of the circumscribed circle diameter shall be taken. The measuring equipment shall extend over at least two adjacent strands.

The average of these four measurements shall be the measured diameter.

2.2.1.5 *Tolerance*

When measured in accordance with Clause 7.3, the measured diameter shall be within the tolerances given in Table 2.2.1.5.

TABLE 2.2.1.5

TOLERANCES ON ROPE DIAMETER

Nominal rope diameter *(d)* mm	Tolerance as percentage of nominal diameter	
	Ropes with strands that are exclusively of wire or incorporate solid polymer centres	Ropes with strands that incorporate fibre centres*
$2 \le d < 4$	+8 0	—
$4 \le d < 6$	+7 0	+9 0
$6 \le d < 8$	+6 0	+8 0
≥ 8	+5 0	+7 0

* For example, 6 × 24 FC

2.2.2 Difference between diameter measurements

The difference between any two of the four measurements taken in accordance with Clause 7.3 and expressed as a percentage of the nominal rope diameter shall not exceed the values given in Table 2.2.2.

TABLE 2.2.2

PERMISSIBLE DIFFERENCES BETWEEN ANY TWO DIAMETER MEASUREMENTS

Nominal rope diameter *(d)* mm	Tolerance as percentage of nominal diameter	
	Ropes with strands that are exclusively of wire or incorporate solid polymer centres	Ropes with strands that incorporate fibre centres*
$2 \le d < 4$	7	—
$4 \le d < 6$	6	8
$6 \le d < 8$	5	7
≥ 8	4	6

* For example, 6 × 24 FC

2.2.3 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 2.2.3).

NOTE: For description of cross-lay, see Clause 2.3.11.

For single-layer ropes of 6 × 7 class, the length of lay (*H*) of the finished rope shall not exceed 8 × rope diameter (*d*).

For other single-layer ropes with round strands (except those with three or four strands), parallel-lay closed ropes and rotation-resistant ropes with round strands or shaped strands, the length of lay (*H*) of the finished rope shall not exceed 7.25 × rope diameter (*d*).

For single-layer ropes with shaped strands, (e.g., triangular strand) the length of lay (*H*) of the finished rope shall not exceed 10 × rope diameter (*d*).

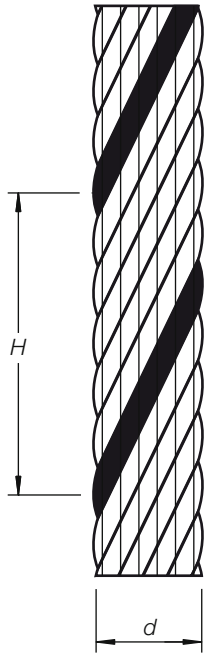


FIGURE 2.2.3 LAY LENGTH—ROPE

2.2.4 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 2.2.4).

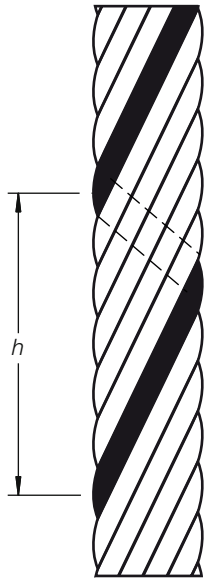


FIGURE 2.2.4 LAY LENGTH—STRAND

2.2.5 Rope length

2.2.5.1 *Measured rope length (L_m)*

Length which corresponds to the actual length supplied using a prescribed method.

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

2.2.5.2 *Nominal rope length (L)*

Length on which the order is usually based.

2.2.5.3 *Rope length*

The length of rope supplied under no load shall be equivalent to the specified length subject to the following tolerances:

(a) ≤400 m ..... +5, −0%.

(b) >400 m and ≤1000 m ..... +20, −0 m.

(c) >1000 m ..... +2, −0%.

2.3 STRANDS AND STRAND TYPES

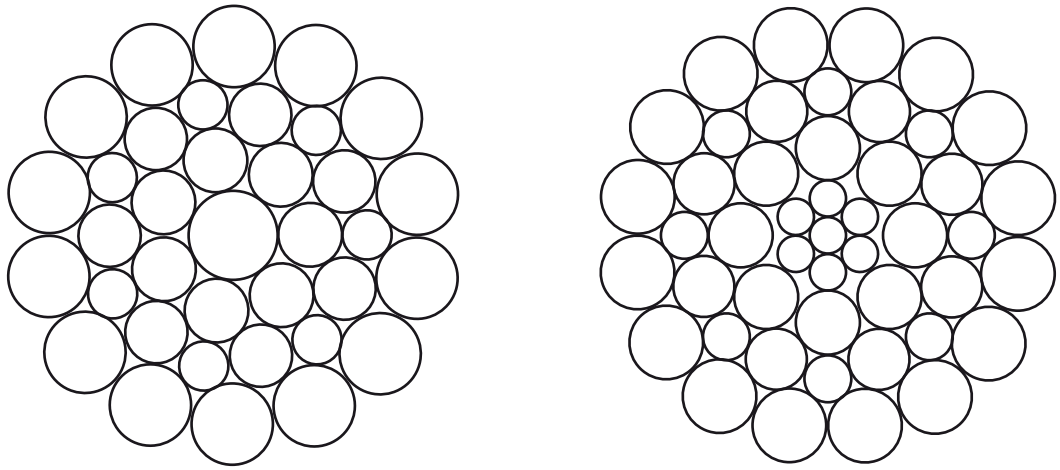
2.3.1 Strand

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.

2.3.2 Round strand

Strand with a perpendicular cross-section which is approximately the shape of a circle (see Figure 2.3.2).



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

FIGURE 2.3.2 ROUND STRAND WITH DIFFERENT CENTRES

2.3.3 Triangular strand V

Strand with a perpendicular cross-section that is approximately the shape of a triangle (see Figure 2.3.3).

NOTE: Triangular strands can have built-up centres.

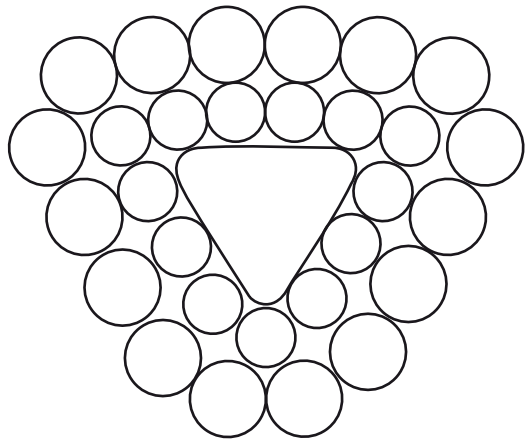


FIGURE 2.3.3 TRIANGULAR STRAND WITH TRIANGULAR (V) CENTRE WIRE

2.3.4 Single lay strand

Strand that contains only one layer of wires (see Figure 2.3.4).

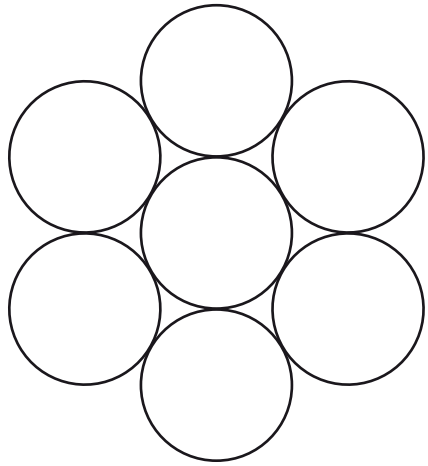


FIGURE 2.3.4 SINGLE LAY STRAND

2.3.5 Parallel lay strand—Equal lay

Strand that 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.

2.3.6 Seale

Parallel lay strand construction with the same number of wires in both layers (see Figure 2.3.6).

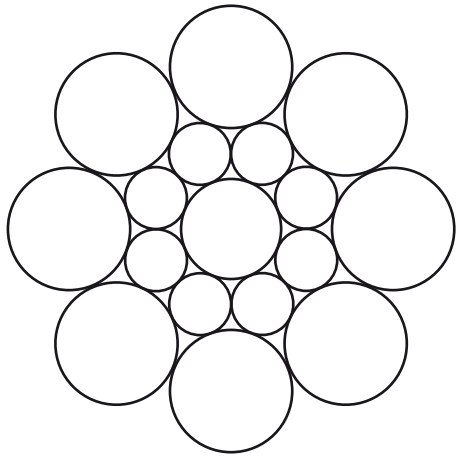


FIGURE 2.3.6 SEALE CONSTRUCTION

2.3.7 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 2.3.7).

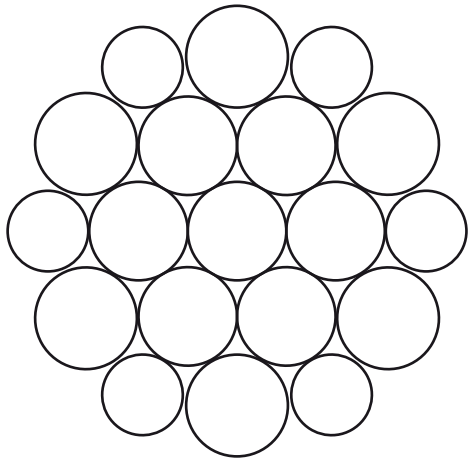


FIGURE 2.3.7 WARRINGTON CONSTRUCTION

2.3.8 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 2.3.8).

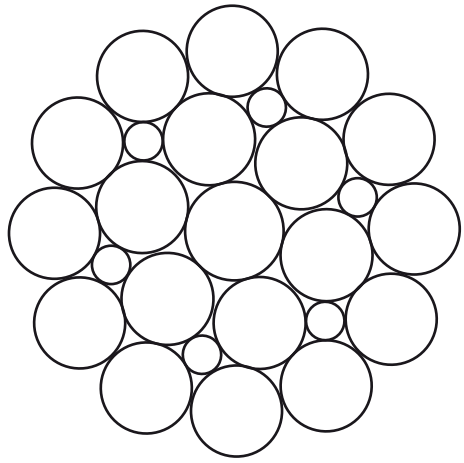


FIGURE 2.3.8 FILLER CONSTRUCTION

2.3.9 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 (see Clause 2.3.7) and Seale (see Clause 2.3.6 and Figure 2.3.9).

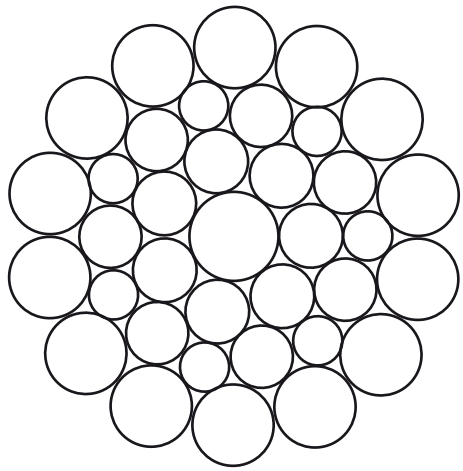


FIGURE 2.3.9 WARRINGTON–SEALE COMBINED PARALLEL LAY—EXAMPLE

2.3.10 Multiple operation lay strand

Construction containing at least two layers of wires in which successive layers are laid in more than one operation.

2.3.11 Cross-lay M

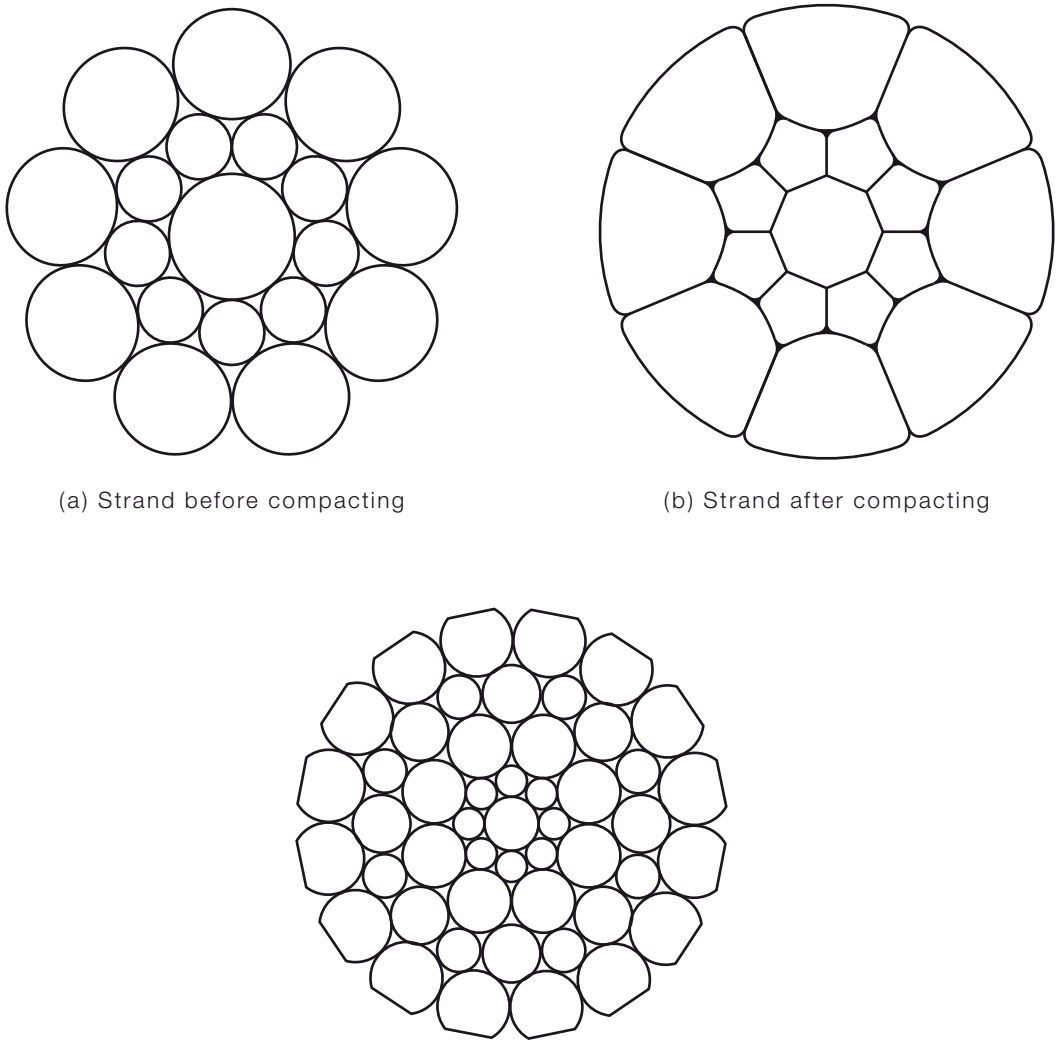
Strand that contains more than one layer of wires, all laid in the same direction, the wires of superimposed wire layers crossing one another and making point contact.

2.3.12 Compound lay N

Strand that contains a minimum of three layers of wires where the outer layer is laid in a separate operation, but in the same direction as the others, over a parallel lay construction forming the inner layers.

2.3.13 Compacted strand K

Strand that 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 2.3.13).



(a) Strand before compacting

(b) Strand after compacting

(c) Partial compacting

FIGURE 2.3.13 COMPACTED STRAND K SHOWING EFFECTS OF COMPACTING—EXAMPLES

2.3.14 Types of strand constructions

The symbols for the more common types of round strand constructions shall be in accordance with Table 2.3.14.

TABLE 2.3.14

SYMBOLS FOR THE MORE COMMON TYPES OF ROUND STRAND CONSTRUCTIONS

Construction type	Symbol	Strand designation	Examples of strand construction
Single lay	No symbol	6 7	(1–5) (1–6)
Parallel lay			
Seale	S	17S	(1–8–8)
		19S	(1–9–9)
Warrington	W	19W	(1–6–6+6)
Filler	F	21F	(1–5–5F–10)
		25F	(1–6–6F–12)
		29F	(1–7–7F–14)
		41F	(1–8–8–8F–16)
Combined parallel lay	WS†	26WS	(1–5–5+5–10)
	(example)	31WS	(1–6–6+6–12)
		36WS	(1–7–7+7–14)
		41WS	(1–8–8+8–16)
		41WS	(1–6/8–8+8–16)
		46WS	(1–9–9+9–18)
		49WS	(1–8+8–16–16)
Multiple operation lay (round strand)			
Cross lay	M	19M	(1–6/12)
		24M	(FC-9-15)
		37M	(1–6/12/18)
Compound lay*	N	35WN	(1–6–6+6/16)
Triangular strand	V	V9	(V–8)
		V10	(V–9)
		V25	(V–12/12)
		V25B	(V–12–12) (built up centre)
		V28B	(V–12/15) (built up centre)

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

† This is one example. This could also be ‘SF’

NOTES:

1 Connecting symbols:
/ = cross lay
\+ = Warrington
– = Seale, single layer or other equal lay strands.

2 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.

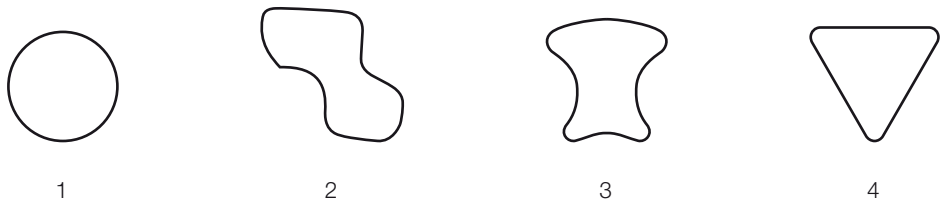
2.4 WIRE

2.4.1 General

Before ropemaking, wires shall conform to the diameter, tensile, other physical properties and, where applicable, coating requirements specified in AS 1394.

NOTE: Examples of wire shapes are shown in Figure 2.4.1.

All wires of the same nominal diameter in the same wire layer shall be of the same tensile strength grade.



LEGEND:

1 = Round
2 = Full-locked (Z)
3 = Half-locked (H)
4 = Triangular (V)

FIGURE 2.4.1 WIRE SHAPES—EXAMPLES

2.4.2 Grade

The tensile grade of wires shall be sufficient to enable the minimum breaking force of the rope to be achieved.

The rope grades for the more common classes of ropes shall be as given in Table 2.4.2 [see Clause 4.3.5 (rope grade R_r)]. Breaking forces for wire rope shall be as given in Tables C1 to C17, Appendix C. Breaking forces for alternative grades shall be supplied by the manufacturer.

Intermediate rope grades may be supplied by agreement between purchaser and the manufacturer provided all of the other requirements are met.

NOTE: Not all ropes will necessarily have a rope grade.

TABLE 2.4.2

TENSILE STRENGTH GRADES OF WIRES (EXCLUDING CENTRE AND FILLER WIRES) FOR GIVEN ROPE GRADES

Rope grade	Range of wire tensile strength grades (N/mm^2, MPa)
1570	1370 to 1770
1770	1570 to 1960
1960	1770 to 2160
2160	1960 to 2160

2.4.3 Outer wires

2.4.3.1 *Outer wire—Spiral rope*

Spiral rope wire positioned in the outer layer of a rope.

NOTE: Spiral is also known as strand.

2.4.3.2 *Outer wire—Stranded rope*

Stranded rope wire positioned in the outer layer of wires in the outer strands of a rope.

2.4.4 Inner wires

2.4.4.1 *Inner wire—Spiral rope*

Wire of the intermediate layers of a rope positioned between the centre wires and outer layer.

2.4.4.2 *Inner wire—Stranded rope*

Any wire of a rope other than its centre wires, filler wires, core wires or outer wires.

2.4.5 Filler wire

Comparatively small wire used in filler constructions to fill up the interstices between layers of wires (see Figure 2.3.8).

2.4.6 Centre wires (king wires)

2.4.6.1 *Centre wire—Spiral rope*

Wire positioned at the centre of a rope.

2.4.6.2 *Centre wire—Stranded rope*

Wire positioned at the centre of the strands of a rope.

2.4.7 Core wire

Wire of the core of a stranded rope.

2.4.8 Loadbearing wire

Wire in a rope regarded as contributing towards the breaking force of the rope.

2.4.9 Layer (of wires)

Assembly of wires having one pitch circle diameter, the first layer being that laid immediately over the strand centre.

NOTES:

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.

2 Filler wires do not constitute a separate layer.

2.4.10 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 are defined by the minimum mass of coating and the adherence of a coating to the steel below.

2.4.11 Mass of coating

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

NOTE: Mass of coating is expressed in grams per square metre.

Table 2.4.11 lists round wire coating masses and comparable classifications in accordance with AS/NZS 4534 and ISO 2408.

TABLE 2.4.11

ZINC COATING CLASSFICATIONS

Nominal diameter of coated wire (*d*) mm	Minimum coating mass, g/m^2	
	Zinc or zinc/aluminium-alloy coating to AS/NZS 4534	
	Class W05 (Comparable to Quality B in ISO 2408)	Class W10 (Comparable to Quality A in ISO 2408)
> 0.19 ≤ 0.23	15	25
> 0.23 ≤ 0.33	25	45
> 0.33 ≤ 0.40	35	60
> 0.40 ≤ 0.46	40	75
> 0.46 ≤ 0.53	50	90
> 0.53 ≤ 0.63	60	105
> 0.63 ≤ 0.75	65	120
> 0.75 ≤ 0.85	70	130
> 0.85 ≤ 0.95	80	140
> 0.95 ≤ 1.06	85	150
> 1.06 ≤ 1.18	90	160
> 1.18 ≤ 1.32	95	170
> 1.32 ≤ 1.55	100	185
> 1.55 ≤ 1.80	110	200
> 1.80 ≤ 2.24	120	215
> 2.24 ≤ 2.72	125	230
> 2.72 ≤ 3.15	130	240
> 3.15 ≤ 3.55	135	250
> 3.55 ≤ 4.25	140	260
> 4.25 ≤ 5.00	150	275
> 5.00 ≤ 8.00	160	290
> 8.00	170	305

NOTE: Refer to AS 1394 for the dimensional and mechanical properties of round wires (before ropemaking).

2.4.12 Wire finish

The finish of the wires shall be uncoated (bright), zinc-coated Class WO5 or zinc-coated Class W10, in accordance with Table 2.4.11.

For ropes of bright wire finish, substitution of bright wires by zinc-coated wires shall be limited to inner wires, centre wires, filler wires and core wires.

For ropes of zinc-coated wire finish, all of the wires shall be zinc coated, including those of any steel core.

Where zinc-coated is specified this may also include zinc alloy Zn95/Al5.

2.5 CORES AND CORE TYPES

2.5.1 Definitions

2.5.1.1 *Core*

Central elements of a round rope around which are laid helically the strands of a stranded rope or the unit ropes of a cable laid rope.

2.5.1.2 *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.

2.5.1.3 *Steel core (WC)*

Core made from steel wires arranged as a wire strand (WSC) or as an independent wire rope (IWRC).

NOTES:

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

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.

2.5.1.4 *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.

2.5.2 Minimum requirements

Cores of single-layer stranded ropes shall normally be of steel or fibre, although other types such as composites (e.g., steel plus fibre or steel plus polymer) or solid polymer may also be supplied.

The purchaser should specify any particular core type requirements.

Fibre cores for single-layer stranded ropes shall conform to ISO 4345 and for rope diameters 8 mm and above shall be doubly closed (that is, from yarn into strand and from strand into rope).

Natural fibre cores shall be treated with an impregnating compound to inhibit rotting and decay.

Steel cores shall be either an independent wire rope (IWRC) or a wire strand (WSC).

Steel cores of single-layer stranded ropes larger than 12 mm diameter shall be an independent wire rope (IWRC), unless specified otherwise.

2.5.3 Designations, 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 2.5.3.

TABLE 2.5.3

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 compact 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 content	FC
Wire strand centre	WSC
Compacted wire strand centre	KWSC

2.6 LUBRICANTS AND PRESERVATION AGENTS

2.6.1 Lubricant

Lubricants shall be in accordance with ISO 4346.

2.6.2 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.

2.6.3 Impregnating agent

Material used in the manufacture of natural fibre cores, coverings or inserts for the purpose of assisting in inhibiting rotting and decay.

2.6.4 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.

2.7 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.

SECTION 3 ROPES AND ROPE TYPES

3.1 STRANDED ROPE

Stranded rope is an 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.

3.2 SINGLE-LAYER ROPE

Single-layer rope is stranded rope consisting of one layer of strands laid helically around a core (see Figure 3.2).

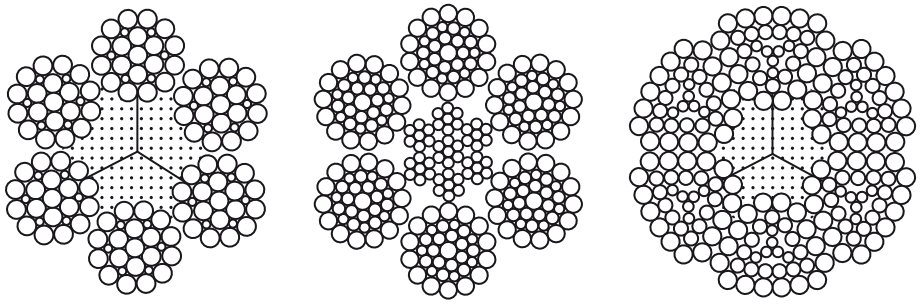


FIGURE 3.2 SINGLE-LAYER STRANDED ROPES—EXAMPLES

3.3 ROTATION-RESISTANT ROPE

Stranded rope designed to generate reduced levels of torque and rotation when loaded (see Figure 3.3).

Rotation-resistant rope has previously been known as non-rotating or multi-strand rope.

NOTES:

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.

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

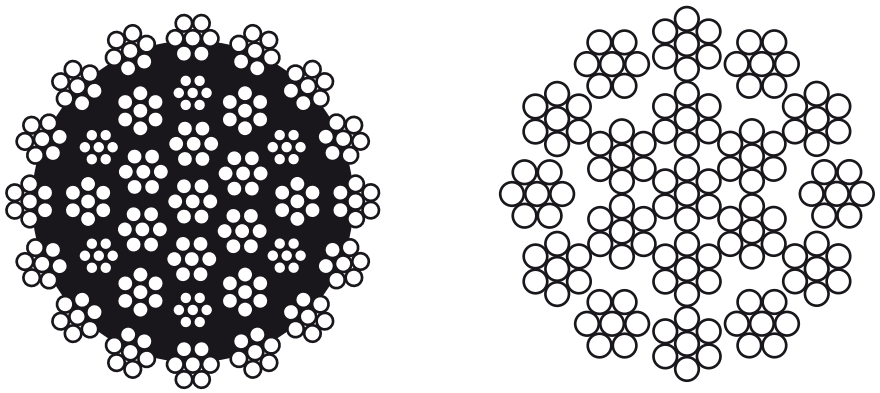


FIGURE 3.3 ROTATION-RESISTANT ROPES—EXAMPLES

3.4 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 3.4).

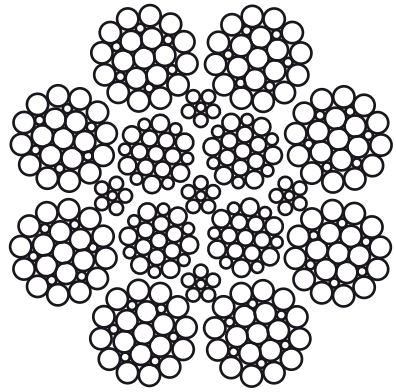


FIGURE 3.4 PARALLEL-CLOSED ROPE—EXAMPLE

3.5 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 (see Figure 3.5).

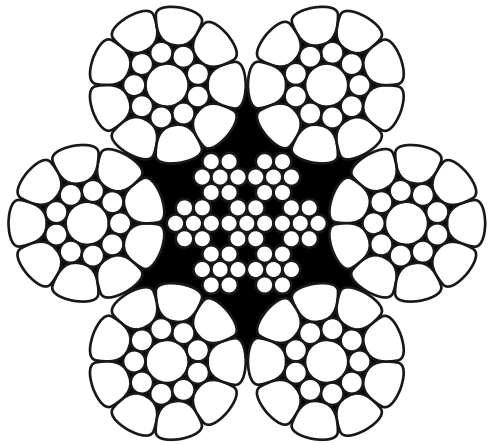


FIGURE 3.5 COMPACTED STRAND ROPE—EXAMPLE

3.6 COMPACTED (SWAGED) ROPE

Stranded rope which is subjected to a compacting (usually swaging) process after closing the rope, thus reducing its diameter (see Figure 3.6).

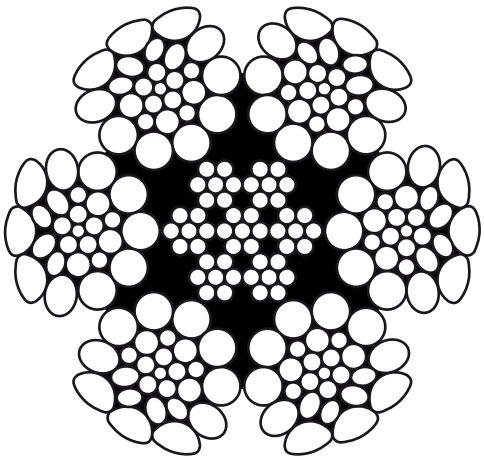


FIGURE 3.6 COMPACTED (SWAGED) ROPE—EXAMPLE

3.7 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 3.7).

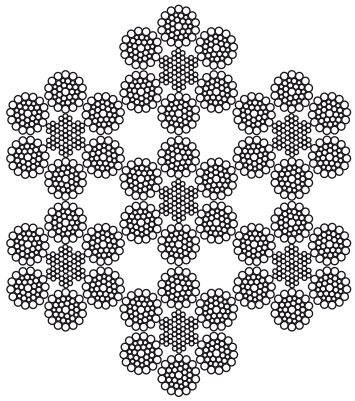


FIGURE 3.7 CABLE-LAID ROPE—EXAMPLE

3.8 BRAIDED ROPE

Assembly of several round strands that are interlaced or plaited together (see Figure 3.8.).

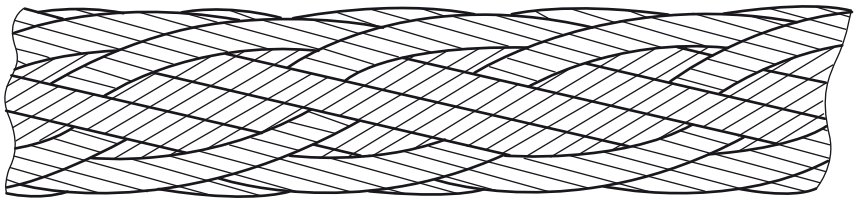


FIGURE 3.8 BRAIDED ROPE—EXAMPLE

3.9 SPIRAL ROPE

3.9.1 General

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).

3.9.2 Spiral strand rope (see AS 2841)

Spiral rope comprising only round wires (see Figure 3.9.2).

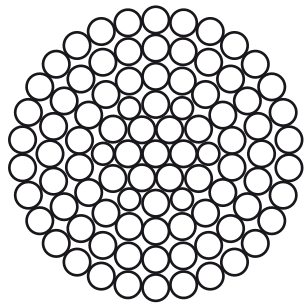


FIGURE 3.9.2 SPIRAL STRAND ROPE—EXAMPLE

3.9.3 Half-locked coil rope

Spiral rope having an outer layer of half-locked (H-shaped) and round wires (see Figure 3.9.3).

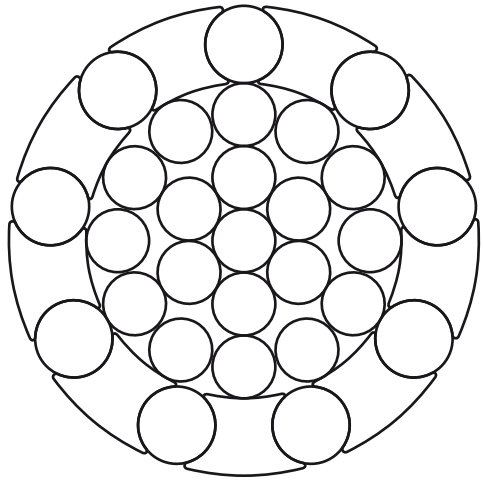


FIGURE 3.9.3 HALF-LOCKED COIL ROPE—EXAMPLE

3.9.4 Full-locked coil rope

Spiral rope having an outer layer of full lock (Z-shaped) wires (see Figure 3.9.4).

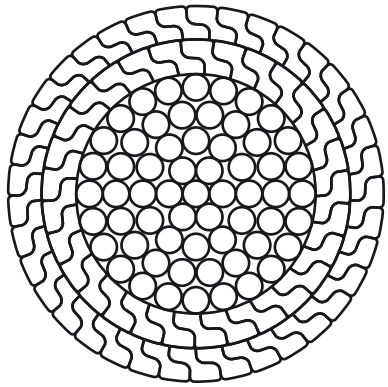


FIGURE 3.9.4 FULL-LOCKED COIL ROPE—EXAMPLE

3.10 ROPES WITH COVERINGS AND/OR FILLINGS

3.10.1 Solid polymer-covered rope

Rope covered (coated) with a solid polymer.

3.10.2 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 3.10.2).

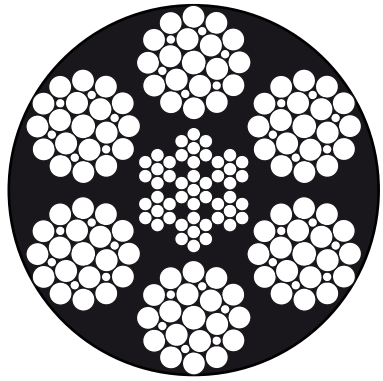


FIGURE 3.10.2 SOLID POLYMER-FILLED ROPE

3.10.3 Solid polymer covered and filled rope

Rope that is covered (coated) and filled with a solid polymer (see Figure 3.10.3).

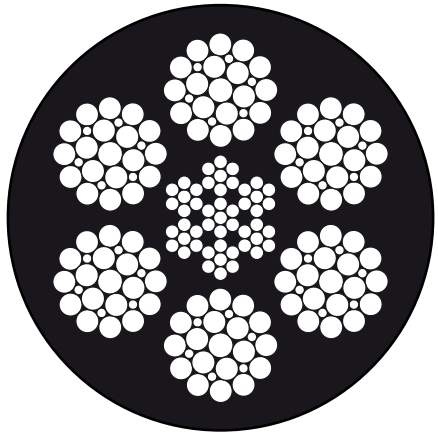


FIGURE 3.10.3 SOLID POLYMER COVERED (COATED) AND FILLED ROPE

3.10.4 Cushioned core rope

Rope in which the core is covered (coated), or filled and covered (coated), with a solid polymer (see Figure 3.10.4).

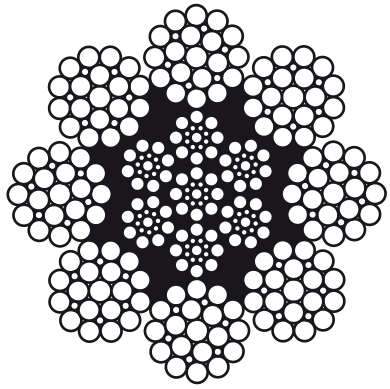


FIGURE 3.10.4 CUSHIONED CORE ROPE—EXAMPLE

3.10.5 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.

SECTION 4 ROPE PROPERTIES

4.1 ROPE CHARACTERISTICS

4.1.1 Torque

'Torque' is a torsional characteristic of a rope that is determined by test or calculation, the value of which is usually expressed in newton metres (Nm) at a stated tensile loading when both rope ends are prevented from rotating.

4.1.2 Turn

'Turn' is a rotational characteristic that is 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.

4.1.3 Fully preformed rope

'Fully preformed rope' is 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.

4.2 ROPE CLASS AND CONSTRUCTION

4.2.1 Rope class

'Rope class' is a grouping of ropes of similar mechanical properties and physical characteristics.

For classification purposes, the minimum breaking force for various rope classes, sizes and grades shall be as specified in Appendix C.

4.2.2 Rope construction

'Rope construction' refers to detail and arrangement of the various elements of the rope.

NOTE: For designation details, see Section 10.

4.3 FACTORS, AREAS, MASSES AND BREAKING FORCES

4.3.1 Fill factor (*f*)

The 'fill factor' is the 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) as follows:

This may be expressed as: $f = \frac{A}{A_u}$

4.3.2 Measured rope length mass (M_m)

'Measured rope length mass' (M_m) is determined by weighing and is expressed in kilograms per 100 m.

4.3.3 Minimum breaking force factor (*K*)

The minimum breaking force factor (K) is an 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 $\pi/4$, as follows:

This may be expressed as: $K = \frac{\pi f k}{4}$

NOTE: K factors for the more common rope classes and constructions are given in Tables C1 to C17 of Appendix C.

4.3.4 Minimum breaking force (F_{min})

The minimum breaking force (F_{min}) is a 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 rope diameter (d), the rope grade (R_r) and the breaking force factor (K), as follows:

$$F_{min} = \frac{d^2 R_r K}{1000}$$

4.3.5 Rope grade (R_r)

Rope grade (R_r) denotes a level of requirement of breaking force, which is designated by a number (e.g. 1770, 1960).

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

4.3.6 Calculated minimum breaking force ($F_{c.min}$)

The calculated minimum breaking force, ($F_{c.min}$) is 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.

4.3.7 Measured breaking force (F_m)

The measured breaking force (F_m) is obtained using a prescribed method.

NOTE: Breaking force testing requirements are specified in Section 6.

4.3.8 Measured aggregate breaking force ($F_{e.m}$)

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

4.3.9 Spinning loss factor (*k*)

The spinning loss factor (k) is the 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.

4.3.10 Calculated minimum aggregate breaking force ($F_{e.c.min}$)

The calculated minimum aggregate breaking force ($F_{e.c.min}$) is calculated 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.

4.3.11 Breaking force tables

The minimum breaking force (F_{min}) for a given rope diameter and construction shall be either—

(a) as given in Tables C1 to C17 of Appendix C; or

(b) as stated by the manufacturer.

For ropes covered by Tables C1 to C17 of Appendix C, the minimum breaking force of intermediate rope diameters shall be calculated using the formula given in Appendix D with the respective minimum breaking force factors as given in Table D1.

When tested in accordance with Clause 7.4.1, the measured breaking force (F_m) shall be greater than or equal to the minimum breaking force (F_{min}).

Breaking force testing requirements shall be in accordance with Table 6.1.

NOTE: The requirements for breaking force testing take into account—

(a) the rope size;

(b) whether or not ropes are produced in series, i.e., repeatedly produced;

(c) whether or not the minimum breaking force factor is consistent throughout a range of diameters; and

(d) whether or not the manufacturer is operating a quality system in accordance with ISO 9001 certified by an accredited third party certification body.

SECTION 5 ROPE MANUFACTURE

5.1 GENERAL

All the wires in a strand shall have the same direction of lay.

The core, except for compacted (swaged) ropes, shall be designed (steel) or selected (fibre) so that in a new rope under tension on the closing machine there is clearance between the outer strands.

The completed rope shall be evenly laid and free from loose wires, distorted strands and other irregularities.

When uncoiled and under no load, the rope shall not be wavy.

Rope ends that have no end fittings shall be secured by means such as seizing, fusing or banding, to maintain the integrity of the rope and prevent its unravelling.

5.2 WIRE JOINTS

Where necessary, wires over 0.4 mm in diameter shall have their ends joined by brazing or welding.

Where necessary, wires up to and including 0.4 mm diameter shall be joined by brazing, welding, twisting or by ends being simply inserted in the strand's formation.

If twisting as a joint is performed during rope manufacture, any protruding twisted wire ends shall be removed from the finished rope.

5.3 LUBRICATION

The amount of lubrication and type of lubricant shall be appropriate to the rope duty and application.

The purchaser should specify the rope duty/application or any particular lubrication requirements.

5.4 PREFORMATION AND POST-FORMATION

Ropes shall be preformed and/or post-formed unless specified otherwise by the purchaser.

NOTE: Some parallel-closed and rotation-resistant ropes may be non-preformed or be only partially preformed.

5.5 CONSTRUCTION

The rope construction shall be either one of those covered by the following classes or a construction, including compacted strand ropes and compacted (swaged) ropes, as stated by the manufacturer:

6×7, 6×24FC, 6×37M, 6×19, 6×36, 8×19, 8×36, 6×25TS, 18×7, $34\text{M} \times 7$ and $35(\text{W}) \times 7$.

Where only the rope class is specified by the purchaser, the supplied construction shall be decided by the manufacturer.

The purchaser should specify the rope construction or class.

NOTE: Information regarding various constructions is detailed in Appendix C.

SECTION 6 ROPES PRODUCED IN SERIES—BREAKING FORCE

Ropes produced in series are multiple lengths of identical ropes produced in the same production program.

The manufacturer shall be able to provide the results from type testing in accordance with the sampling and acceptance criteria in Appendix B.

Type testing shall be repeated on any rope that has its design changed in any way that results in a modified (e.g., increased) breaking force. If the same design, apart from wire tensile strength grades, is used for ropes of a lower grade or lower breaking force, or both, than the one which has successfully passed the type testing requirements, it shall not be necessary to repeat the tests on those ropes provided the breaking force is calculated with the same spinning loss. Subsequent production lengths of ropes produced in series shall be deemed to conform to the breaking force requirements when the manufacturer has satisfactorily completed—

(a) the appropriate type tests (see Appendix B); and

(b) a periodic breaking force test in accordance with Method 1 (see Clause 7.4.1) or one of the alternative methods, known as Methods 2 and 3 (see Clauses 7.4.2 and 7.4.3), on a sample from every twentieth production length.

Table 6.1 lists breaking force testing requirements.

TABLE 6.1

BREAKING FORCE TESTING REQUIREMENTS

Minimum breaking force factor	Manufacturer operating a quality system in accordance with ISO 9001, certified by an accredited third party certification body	Manufacturer NOT operating a quality system in accordance with ISO 9001, certified by an accredited third party certification body
Same factor throughout a subgroup of rope diameters	Breaking force test in accordance with Clause 7.4.1 (Method 1) on a sample from each production length; or, if produced in series. Type testing in accordance with the sampling regime and acceptance criteria of Paragraph B1 plus periodic breaking force test in accordance with Clause 7.4.1 (Method 1), Clause 7.4.2 (Method 2) or Clause 7.4.3 (Method 3) on a sample from every twentieth production length relating to the subgroup of diameters	Breaking force test in accordance with Clause 7.4.1 (Method 1) on a sample from each production length
Different factors throughout a subgroup of rope diameters	Breaking force test in accordance with Clause 7.4.1 (Method 1) on a sample from each production length, or if produced in series. Type testing in accordance with the sampling regime and acceptance criteria of Paragraph B2 plus periodic test in accordance with Clause 7.4.1 (Method 1), Clause 7.4.2 (Method 2) or Clause 7.4.3 (Method 3) on a sample from every twentieth production length of a given rope diameter and construction	Breaking force test in accordance with Clause 7.4.1 (Method 1) on a sample from each production length

NOTE: Breaking force type testing demonstrates that a steel wire rope produced in series and certified by the manufacturer as conforming to this Standard possesses the minimum breaking force stated by the manufacturer. The purpose of these tests is to prove the design, material and method of manufacture.

SECTION 7 VERIFICATION OF REQUIREMENTS AND TEST METHODS

7.1 MATERIALS

Compliance with the wire, core and lubricant requirements shall be confirmed through a visual verification of the inspection documents supplied with the wire, core and lubricant respectively.

Where testing of wires taken from the rope is required such testing shall be in accordance with Appendix E.

7.2 ROPE MANUFACTURE

Compliance with the requirements for wire joints and preformation shall be confirmed through visual verification.

7.3 TEST ON ROPE FOR DIAMETER

Rope diameters shall be measured in accordance with Clause 2.2.1. Rope diameters shall comply with the requirements in Clause 2.2.1.

7.4 TEST ON ROPE FOR BREAKING FORCE

7.4.1 Method 1—Measured breaking force (F_m)

The method of test and acceptance criteria shall be in accordance with ISO 3108 except for the following:

(a) The selected test piece shall have its ends secured to ensure that the rope does not unravel.

(b) The minimum free test length, excluding any rope terminations, shall be 600 mm or 30 × nominal rope diameter, whichever is the greater.

(c) After 80% of the minimum breaking force has been applied, the force shall be increased at a rate of not more than 0.5% of the minimum breaking force per second.

(d) When the minimum breaking force is reached or exceeded, the test may be terminated without breaking the rope.

(e) The test may be discounted where the rope fractures within a distance equivalent to six rope diameters from the base of the grip or the termination and the minimum breaking force has not been reached.

(f) When the minimum breaking force value is not reached, three additional tests may be carried out, one of which shall achieve or exceed the minimum breaking force value.

7.4.2 Method 2—Calculated measured (post-spin) breaking force

Add together the measured breaking forces of all the individual wires after they have been removed from the rope and multiply this value by either—

(a) the spinning loss factor derived from Appendix D; or

(b) the partial spinning loss factor obtained from the results of type testing.

The partial spinning loss factor used in the calculation shall be the lowest of the three values obtained from type testing.

In the case of triangular strand ropes, the triangular centre of the strand may be considered as an individual wire.

The wires shall be tested in accordance with the wire tensile test specified in ISO 6892. When this method (i.e., Method 2) is used for the periodic test (see Table 6.1) and the calculated measured (post-spin) breaking force value is less than the intended minimum breaking force value, another test using Method 1 shall be carried out.

NOTE: The result from this test is known as the 'calculated measured (post-spin) breaking force'.

If the measured (actual) breaking force in this second test fails to meet the intended minimum breaking force value, the minimum breaking force shall be de-rated to a value not exceeding the measured (actual) breaking force value and type testing shall be repeated using Method 1.

In such cases, the rope grade shall either be de-rated in line with the de-rated minimum breaking force value or deleted from the rope designation.

7.4.3 Method 3—Calculated measured (pre-spin) breaking force

Add together the measured breaking forces of all the individual wires before they are laid into the rope and multiply this value by the total spinning loss factor obtained from the results of type testing. The total spinning loss factor used in the calculation shall be the lowest value of the three values obtained from type testing.

The wires shall be tested in accordance with the wire tensile test specified in ISO 6892.

NOTE: The result from this test is known as the 'calculated measured (pre-spin) breaking force'.

When this method (i.e., Method 3) is used for the periodic test (see Table 6.1) and the calculated measured (pre-spin) breaking force value is less than the intended minimum breaking force value, another test using Method 1 shall be carried out.

If the measured breaking force in this second test fails to meet the intended minimum breaking force value, the minimum breaking force shall be de-rated to a value not exceeding the measured breaking force value and type testing shall be repeated using Method 1.

In such cases, the rope grade shall either be de-rated in line with the de-rated minimum breaking force value or deleted from the rope designation.

7.4.4 Breaking force based on component tests

For six-strand rope (round or triangular strand) and eight-strand rope having a breaking force in excess of 1500 kN, the following method of test is allowed as an additional alternative to the methods of testing referred to above. Each of the component strands and, if applicable, the wire rope core from a sample of the completed rope is tested and the rope breaking force is calculated from the component strand and core tests as follows:

(a) For wire rope with either six or eight round strands:

$$\text{Rope breaking force} = \begin{matrix}\text{sum of the test breaking force} \\ \text{of each strand} \times 0.925\end{matrix} + \begin{matrix}\text{IWRC test breaking force} \\ \times 0.45\end{matrix}$$

(b) For wire rope with six triangular strands:

$$\text{Rope breaking force} = \begin{matrix}\text{sum of the test breaking force} \\ \text{of each strand} \times 0.95\end{matrix} + \begin{matrix}\text{IWRC test breaking force} \\ \times 0.45\end{matrix}$$

The calculated rope breaking force above is considered equivalent to the test breaking force of the complete rope.

NOTE: This method of calculation of rope breaking force is not considered appropriate for multi-strand rotation-resistant ropes.

SECTION 8 CERTIFICATION

8.1 CERTIFICATE

A certificate that confirms compliance with this Standard shall be issued.

Unless specified otherwise by the purchaser, the certificate shall include at least the following information:

(a) Certificate number.

(b) Name and address of the manufacturer.

(c) Quantity and nominal length of rope (optional).

(d) Rope designation (see Section 9).

(e) Minimum breaking force.

(f) Date of issue of the certificate and authentication.

(g) The name and address of the testing establishment.

(h) The name of the signatory.

(i) The type of certificate.

NOTES:

1 The manufacturer should retain an original test certificate for not less than 10 years.

2 The issuing of a certificate by the manufacturer and whether or not, and which, test results are given should be the subject of agreement between the purchaser and the manufacturer.

3 Certificate types include NATA, certifying authority or supplier.

The certificate number shall enable traceability of the rope.

8.2 TEST RESULTS

When test results are provided, the certificate shall additionally give either one of the following:

(a) Breaking force test on rope—state which value, that is—

  (i) measured breaking force;

  (ii) calculated measured (post-spin) breaking force; or

  (iii) calculated measured (pre-spin) breaking force.

(b) Tests on wires—

  (i) number of wires tested;

  (ii) nominal diameter of wires;

  (iii) measured breaking force of wire;

  (iv) tensile strength based on nominal diameter;

  (v) number of torsions completed (and test length); and

  (vi) mass of coating.

SECTION 9 PACKAGING AND MARKING

9.1 PACKAGING

Ropes shall be supplied on reels.

The purchaser should specify any particular packaging requirements.

9.2 MARKING

The following shall be legibly and durably marked on the reel:

(a) The manufacturer's name.

(b) Nominal diameter.

(c) Rope construction.

(d) Tensile grade.

(e) Finish.

(f) Length.

(g) Reel number, or batch number.

SECTION 10 DESIGNATION

10.1 GENERAL

The system for designating steel wire ropes shall be in accordance with Clauses 10.2 to 10.4. 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. The features listed in Items (a) to (f) of Clause 10.2 may also be used for the purposes of rope identification.

10.2 FORMAT

The designation system shall consist of the following (see Clause 10.4).

NOTE: Figure 10.2 for examples:

1 Dimension(s).

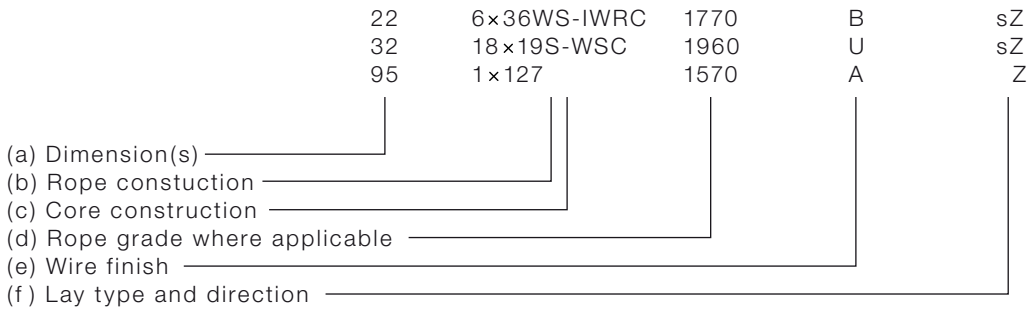
2 Rope construction.

3 Core construction.

4 Rope grade, where applicable.

5 Wire finish.

6 Lay type and direction.



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

FIGURE 10.2 DESIGNATION SYSTEM—EXAMPLES

10.3 CROSS-SECTIONAL SHAPE SYMBOLS

The symbols for cross-sectional shape shall be in accordance with Table 10.3.

TABLE 10.3

CROSS-SECTIONAL SHAPE SYMBOLS

Cross-sectional shape	Symbol		
	Wire	Strand	Rope
Round	No symbol	No symbol	No symbol
Triangular	V	V	—
Built-up centre*	—	B	—
Z-shaped	Z	—	—
H-shaped	H	—	—
Compacted†	—	K	K
Braided	—	—	BR

* Symbol B indicates that the strand centre is built up from a number of wires and succeeds the symbol for strand shape; for example, a triangular strand of 25 wires with a built up centre would be designated as V25B

† Symbol K indicates an additional compacting process and precedes the symbol for strand or rope shape and construction; for example, a compacted round strand of 26 wires Warrington–Seale construction would be designated K26WS

10.4 DESIGNATION OF KEY FEATURES

10.4.1 General

The assembly of the designations of the key features shall be in the sequence of the requirements of Clauses 10.4.2 to 10.4.7 below.

NOTE: Where applicable, the manufacturer's unique identifier or brand name should also be stated.

10.4.2 Dimension(s)

For round rope and braided rope, the nominal diameter shall be 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).

NOTE: Care should be taken to ensure correct wire rope diameter and outside diameter of covered wire rope is supplied as required by the purchaser. The designation has historically been expressed with the wire rope diameter first (e.g., 11.5/13.0).

10.4.3 Construction

10.4.3.1 *Stranded ropes*

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

(a) Single layer rope:

(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 (see Table 2.3.14).

(iv) Connecting symbol dash (–).

(v) The core designation (see Table 2.5.3).

Example:

6 × 36WS–IWRC.

NOTE: For additional examples, see Appendix A.

(b) Parallel-closed rope:

(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 (see Table 2.3.14).

(iv) Connecting symbol dash (–).

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

Example:

8 × 19S–PWRC.

NOTE: For additional examples, see Appendix A.

(c) Rotation-resistant rope (10 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:

35 × 7 or 19 × 7.

NOTE: For additional examples, see Appendix A.

10.4.3.2 *Spiral ropes*

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

(a) Spiral strand:

NOTE: For spiral strand see AS 2841.

(i) 1.

(ii) Multiplication sign (×).

(iii) Number of wires in the strand.

Example:

1×61.

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

(i) Half-locked coil.

(ii) HLGR for guide rope.

(iii) HLAR for aerial track rope.

(c) Full-locked coil:

(i) FLAR for aerial track (or carrying) rope.

(ii) FLHR for hoisting rope.

(iii) FLSR for structural rope.

10.4.4 Core construction

The core construction shall be designated in accordance with Table 2.5.3.

10.4.5 Rope grade

When given, the rope grade shall identify the level of breaking force of the rope, as specified in Table 2.4.2.

NOTE: Not all ropes are identified by a rope grade.

10.4.6 Surface finish of wire

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

(a) Bright or uncoated ..... U.

(b) Zinc-coated Class B ..... B.

(c) Zinc-coated Class A ..... A.

(d) Zinc-alloy-coated Class B ..... B(Zn/A1).

(e) Zinc-alloy-coated Class A ..... A(Zn/A1).

With other finishes, it will be necessary to ensure that the meaning of any selected letter symbol is identified (see Table 2.4.11).

10.4.7 Type of lay and direction

10.4.7.1 *Spiral rope*

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

Right lay: Z

Left lay: S

10.4.7.2 *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.

APPENDIX A

DESIGNATION SYSTEM

(Informative)

A1 STRAND CONSTRUCTION FOR STRANDED ROPES

Figure A1 provides an example of designation for strand construction for stranded ropes.

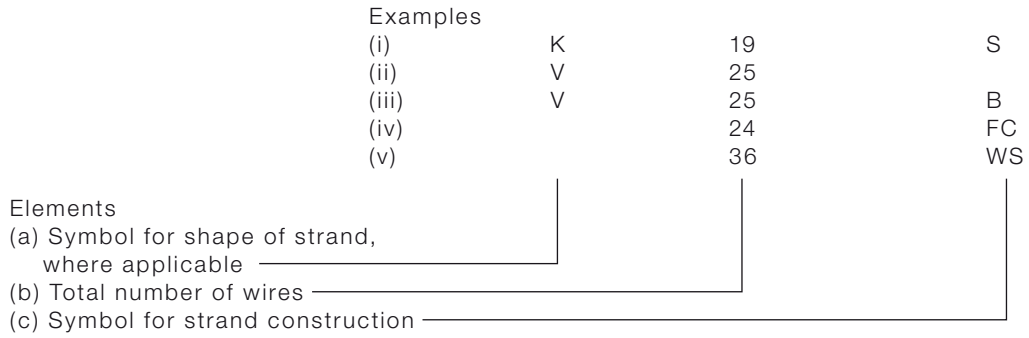


FIGURE A1 STRAND CONSTRUCTION FOR STRANDED ROPES—DESIGNATION EXAMPLE

A2 ROPE CONSTRUCTION

A2.1 Spiral strand

Figure A2 provides an example of designation for spiral strand.

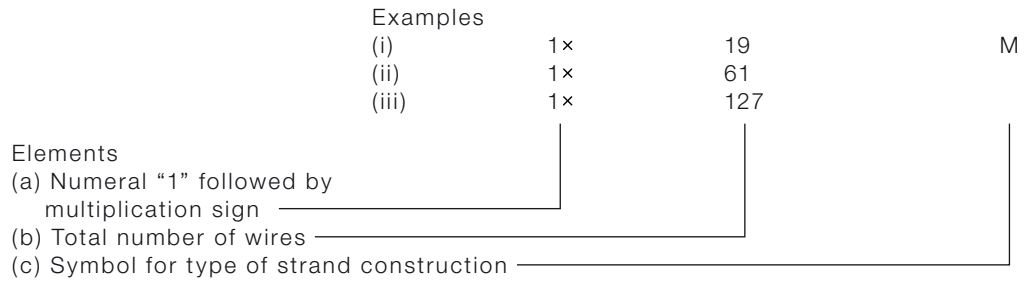


FIGURE A2 SPIRAL STRAND—DESIGNATION EXAMPLE

A2.2 Stranded rope

A2.2.1 *Single layer stranded rope*

Figure A3 provides an example of designation for single layer stranded rope.

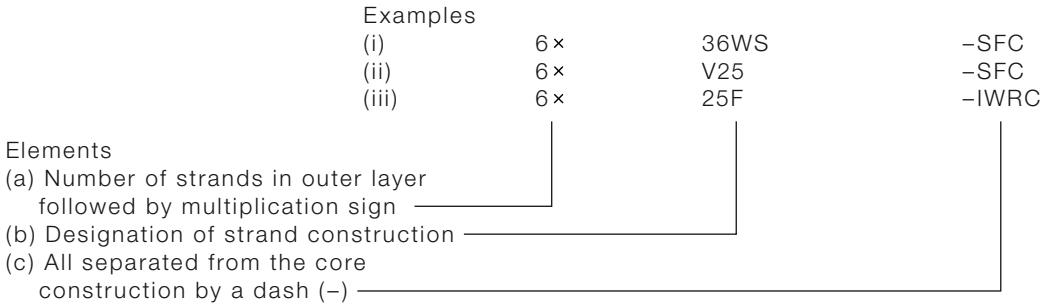


FIGURE A3 SINGLE LAYER STRANDED ROPE—DESIGNATION EXAMPLE

A2.2.2 *Rotation-resistant rope*

Figure A4 provides an example of designation for rotation-resistant rope.

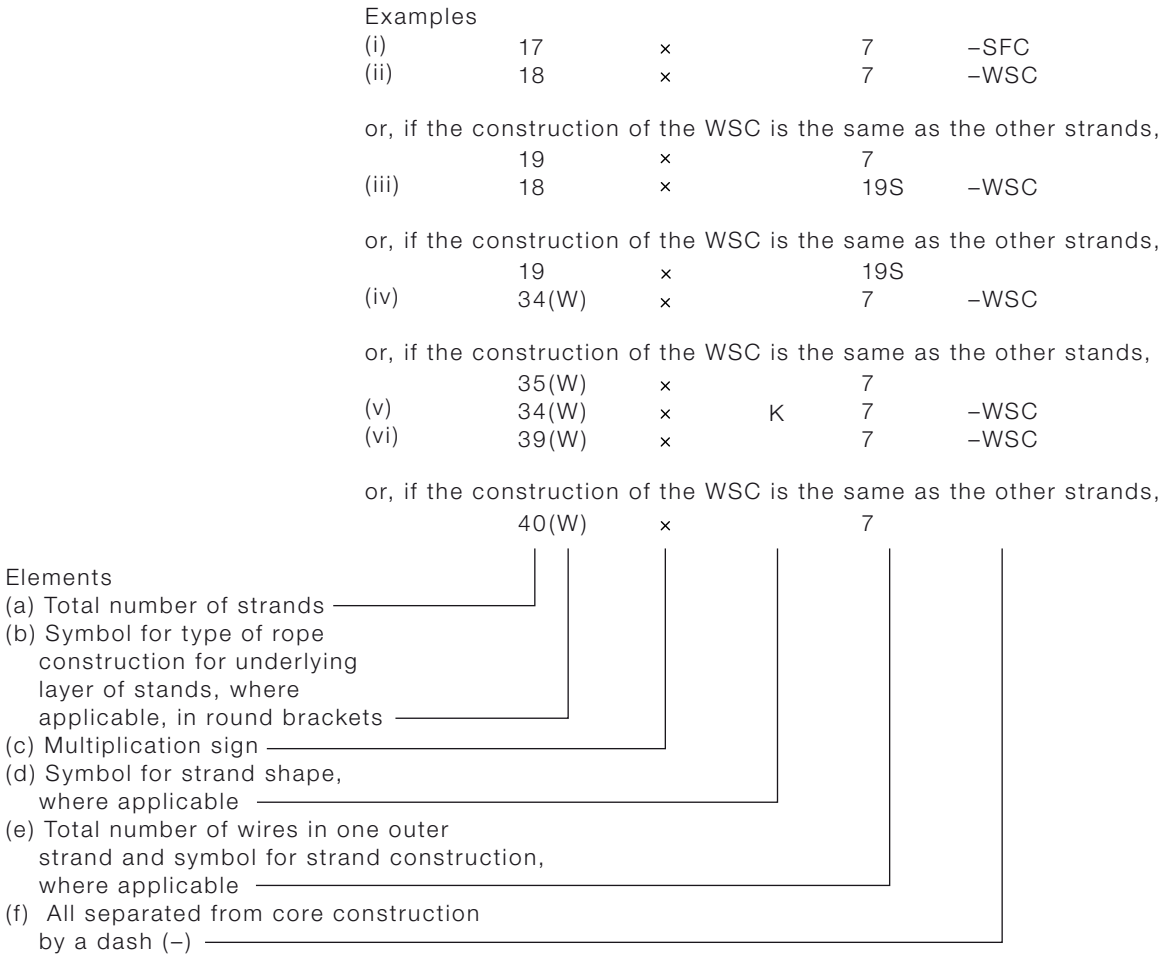


FIGURE A4 ROTATION-RESISTANT ROPE—DESIGNATION EXAMPLE

A2.2.3 *Parallel-closed rope*

Figure A5 provides an example of designation for parallel-closed rope.

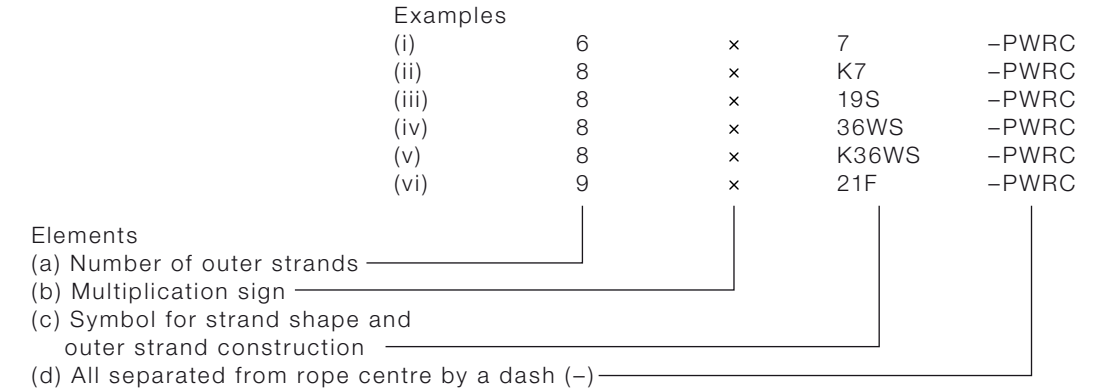


FIGURE A5 PARALLEL-CLOSED ROPE—DESIGNATION EXAMPLE

A2.2.4 *Cable-laid rope*

Figure A6 provides an example of designation for parallel-closed rope.

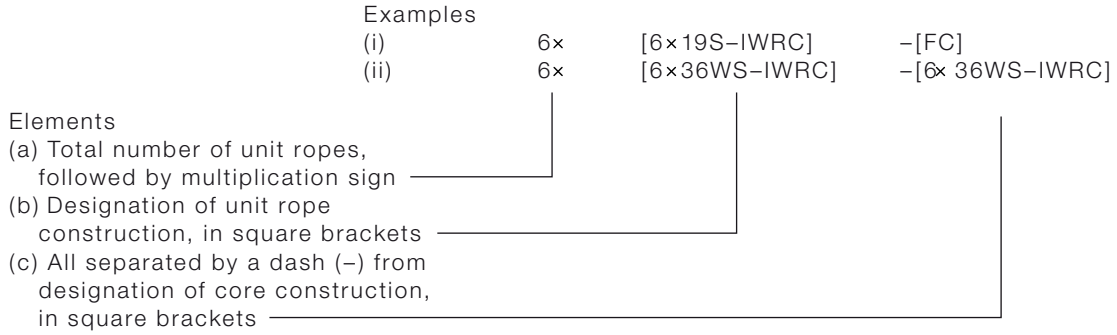


FIGURE A6 CABLE-LAID ROPE—DESIGNATION EXAMPLE

APPENDIX B

SAMPLING AND ACCEPTANCE CRITERIA FOR TYPE TESTING OF ROPES PRODUCED IN SERIES

(Normative)

B1 ROPES HAVING SAME MINIMUM BREAKING FORCE FACTOR THROUGHOUT ROPE DIAMETER SUBGROUP

The manufacturer shall divide the intended size range into subgroups based on the following:

(a) Nominal diameter up to and including 6 mm.

(b) Over 6 mm up to and including 12 mm.

(c) Over 12 mm up to and including 24 mm.

(d) Over 24 mm up to and including 48 mm.

(e) Over 48 mm up to and including 60 mm.

(f) Over 60 mm up to and including 100 mm.

(g) Over 100 mm.

For each of the subgroups representing the intended range and having the same construction, grade and minimum breaking force factor, the manufacturer shall perform a breaking force test in accordance with Clause 7.4 on a sample from each of three separate production lengths of rope of different nominal diameters.

If all three samples pass the test, all rope sizes within that subgroup of that particular rope construction, grade and minimum breaking force factor shall be deemed to have satisfied the type testing requirements; otherwise, breaking force testing shall continue on a sample from each consecutive production length of rope within that subgroup until the requirements are met.

B2 ROPES HAVING DIFFERENT MINIMUM BREAKING FORCE FACTORS THROUGHOUT ROPE DIAMETER SUBGROUP

The manufacturer shall perform a breaking force test in accordance with Clause 7.4.1 on a sample from each of three separate production lengths of rope of the same nominal diameter.

If all three samples pass the test, the diameter and construction having that particular minimum breaking force factor shall be deemed to have satisfied the breaking force type testing requirements.

If any one of the samples fails the test, the tests shall be repeated until the measured breaking forces of three consecutive production lengths of that rope diameter and construction meet or exceed the minimum breaking force value.

APPENDIX C

TABLES OF MINIMUM BREAKING FORCES FOR VARIOUS ROPE CLASSES, SIZES AND GRADES

(Normative)

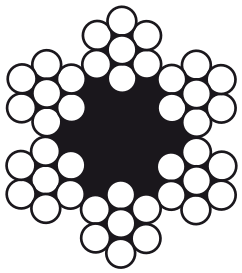
Tables C1 to C17 present the minimum breaking forces for the various classes, sizes and grades of rope.

Higher values of minimum breaking force than those given in these tables may be specified by the manufacturer.

NOTE: The values of approximate nominal length mass are given for information.

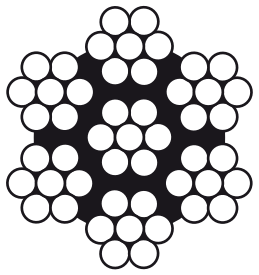
TABLE C1

CLASS 6 × 7 WITH FIBRE CORE

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	6 × 7–FC	1–6	36	6

Nominal rope diameter *(d)*	Approximate nominal length mass	Minimum breaking force		
		Grade 1570	Grade 1770	Grade 1960
mm	kg/100 m	kN	kN	kN
2	1.3	2.1	—	—
3	3.1	4.7	—	—
3.5	4.2	6.4	—	—
4	5.5	8.4	—	—
5	8.6	13.1	—	—
6	12.4	18.8	21.2	23.4
7	16.9	19.3	21.8	31.9
8	22.1	33.4	37.6	41.6
9	27.6	42.2	47.6	52.7
10	34.5	52.2	58.8	65.1
11	41.7	63.1	71.1	78.7
12	49.7	75.0	84.6	93.7
13	58.3	88.1	99.3	110
14	67.6	102	115	128
16	88.3	133	150	167
18	112	169	190	211
19	125	188	212	235
20	138	208	235	260
22	167	252	284	315
24	199	—	338	375
26	233	—	397	440
28	270	—	461	510
32	353	—	602	666
35	423	—	720	797
35	423	—	720	797
36	447	—	762	843
38	498	—	849	940
40	552	—	940	1040

TABLE C2
CLASS 6 × 7 WITH STEEL CORE

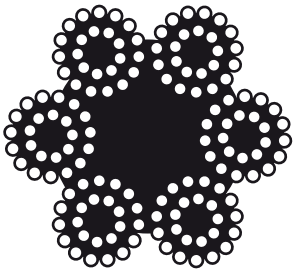
Typical cross-section	Typical construction			
	Rope construction*	Strand construction	Outer wires	
			Total	Per strand
	6 × 7–WSC	1–6	36	6
	6 × 7–IWRC	1–6	36	6

Nominal rope diameter (*d*)	Approximate nominal length mass	Minimum breaking force[a]		
		Grade 1570	Grade 1770	Grade 1960
mm	kg/100 m	kN	kN	kN
2	1.5	2.3	—	—
3	3.5	5.1	—	—
3.5	4.7	6.9	—	—
4	6.1	9.0	—	—
5	9.6	14.1	—	—
6	13.8	20.3	22.9	25.3
7	18.8	27.6	31.1	34.5
8	24.6	36.1	40.7	45.0
9	31.1	45.7	51.5	57.0
10	38.4	56.3	63.5	70.4
11	46.5	68.2	76.9	85.1
12	55.3	81.2	91.5	101
13	34.9	94.9	107	119
14	75.3	111	125	138
16	96.3	145	163	180
18	124	183	206	228
19	139	203	229	254
20	154	225	254	281
22	186	273	308	341
24	221	—	366	405
26	260	—	430	476
28	301	—	498	552
32	393	—	651	721
35	470	—	778	778
36	498	—	824	912
38	554	—	918	1020
40	614	—	1020	1130

*WSC is usually used to about 7 mm. Thereafter most commonly IWRC

TABLE C3

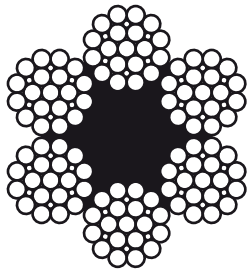
CLASS 6 × 24FC WITH FIBRE CORE

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	6 × 24FC–FC	FC–12/12	72	12
	6 × 24FC–FC	FC–9/15	90	15

Nominal rope diameter *(d)*	Approximate nominal length mass	Minimum breaking force
		Grade 1570
mm	kg/100 m	kN
8	20.1	28.7
9	25.4	36.4
10	31.4	44.9
11	38.0	54.3
12	45.2	64.
13	53.1	75.9
14	61.5	88.0
16	80.4	115
18	102	145
19	113	162
20	126	180
22	152	217
24	181	259
26	212	304
28	246	352
32	322	460
35	385	550
36	407	582
38	453	648
40	502	718

TABLE C4

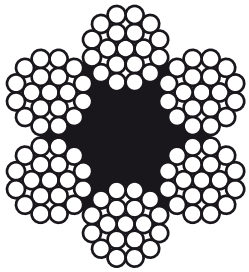
CLASS 6 × 19 WITH FIBRE CORE

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	6 × 19S–FC	1–9–9	54	9
	6 × 21F–FC	1–5–5F–10	60	10
	6 × 26WS–FC	1–5–5+5–10	60	10
	6 × 19W–FC	1–6–6+6	36	12
	6 × 25F–FC	1–6–6F–12	72	12

Nominal rope diameter *(d)*	Approximate nominal length mass	Minimum breaking force			
		Grade 1570	Grade 1770	Grade 1960	Grade 2160
mm	kg/100 m	kN	kN	kN	kN
6	12.9	18.6	21.0	23.3	25.7
7	17.6	25.4	28.6	31.7	34.9
8	23.0	33.2	37.4	41.4	45.6
9	29.1	42.0	47.3	52.4	57.7
10	35.9	51.8	58.4	64.7	71.3
11	43.3	62.7	70.7	78.3	86.2
12	51.7	74.6	84.1	93.1	103
13	60.7	87.5	98.7	109	120
14	70.4	101	114	127	140
16	91.9	133	150	166	182
18	116	168	189	210	231
19	130	115	211	233	257
20	144	208	234	259	285
22	174	251	283	313	345
24	207	—	336	373	411
26	243	—	395	437	482
28	281	—	458	507	559
32	368	—	598	662	730
35	440	—	716	792	873
36	465	—	757	838	924
38	518	—	843	934	1030
40	574	—	935	1040	1140
44	695	—	1130	1250	1380
45	727	—	1180	1310	1140
48	827	—	1350	1490	1640
51	934	—	1520	1680	1850
52	971	—	1580	1750	1930
56	1130	—	1830	2030	2240
60	1290	—	2100	2330	2570

TABLE C5

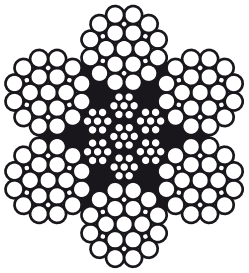
CLASS 6 × 19M WITH FIBRE CORE

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	6 × 19–FC	1–6–12	72	19

Nominal rope diameter *(d)* mm	Approximate nominal length mass kg/100 m	Minimum breaking force Grade 1570 kN
3.5	4.2	5.8
4	5.5	7.7
5	8.6	12.0
6	12.4	17.6
7	16.9	23.4
8	22.1	30.9
9	28.0	39.1
10	34.6	48.2
11	41.9	58.4
12	49.8	69.5
13	58.5	81.5
14	67.8	94.6
16	88.6	124
18	112	156
19	125	175
20	138	193
22	167	234
24	199	278

TABLE C6

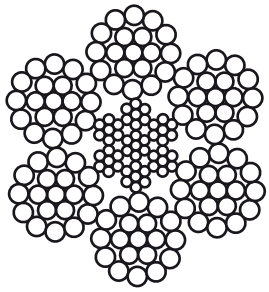
CLASS 6 × 19 WITH STEEL CORE

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	6 × 19S–IWRC	1–9–9	54	9
	6 × 21F–IWRC	1–5–5F–10	60	10
	6 × 26WS–IWRC	1–5–5+5–10	60	10
	6 × 19W–IWRC	1–6–6+6	36	12
	6 × 25F–IWRC	1–6–6F–12	72	12

Nominal rope diameter *(d)*	Approximate nominal length mass	Minimum breaking force			
		Grade 1570	Grade 1770	Grade 1960	Grade 2160
mm	kg/100 m	kN	kN	kN	kN
6	14.4	20.1	22.7	25.1	27.7
7	19.6	27.4	30.9	34.2	37.7
8	25.6	35.7	40.3	44.7	49.2
9	32.4	45.2	51.0	56.5	62.3
10	40.0	55.9	63.0	69.8	76.9
11	48.4	67.6	76.2	84.4	93.0
12	57.6	80.5	90.7	100	111
13	67.6	94.0	106	118	130
14	78.4	110	124	137	151
16	102	143	161	179	197
18	130	181	204	226	249
19	144	201	227	252	278
20	160	224	252	279	308
22	194	271	305	338	372
24	230	—	363	402	443
26	270	—	426	472	520
28	314	—	494	547	603
32	410	—	645	715	787
35	490	—	772	855	942
36	518	—	817	904	997
38	578	—	940	1010	1110
40	640	—	1010	1120	1230
44	774	—	1220	1350	1490
45	810	—	1280	1410	1560
48	922	—	1450	1610	1770
51	1040	—	1640	1810	2000
52	1080	—	1700	1890	2080
56	2250	—	1980	2190	2410
60	1440	—	2270	2510	2770

TABLE C7

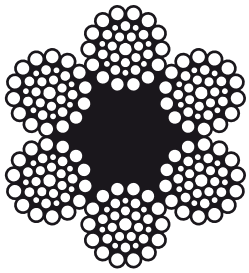
CLASS 6 × 19M WITH STEEL CORE

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	6 × 19M–WSC	1–6–12	72	12
	6 × 19M–IWRC	1–6–12	72	12

Nominal rope diameter *(d)* mm	Approximate nominal length mass kg/100 m	Minimum breaking force Grade 1570 kN
3.5	4.6	6.4
4	6.1	8.5
5	9.5	13.2
6	13.7	19.3
7	18.7	25.8
8	24.4	33.3
9	30.8	42.2
10	38.1	52.1
11	46.1	63.1
12	54.8	75.0
13	64.3	88.1
14	74.6	102
16	97.4	133
18	123	169
19	137	188
20	152	208
22	184	252
24	219	300

TABLE C8

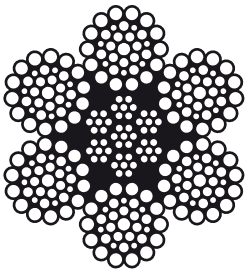
CLASS 6 × 36 WITH FIBRE CORE

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	6 × 31WS–FC	1–6–6+6–12	72	12
	6 × 36WS–FC	1–7–7+7–14	84	14
	6 × 41WS–FC	1–8–8+8–16	96	16
	6 × 41F–FC	1–8–8–8F–16	96	16
	6 × 49WS–FC	1–8–8–8+8–16	96	16
	6 × 46WS–FC	1–9–9+9–18	108	18

Nominal rope diameter *(d)*	Approximate nominal length mass	Minimum breaking force		
		Grade 1770	Grade 1960	Grade 2160
mm	kg/100 m	kN	kN	kN
7	18.0	28.6	31.7	34.9
8	23.5	37.4	41.4	45.6
9	29.7	47.3	52.4	57.7
10	36.7	58.4	64.7	71.3
11	44.4	70.7	78.3	86.2
12	52.8	84.1	93.1	103
13	62.0	98.7	109	120
14	71.9	114	127	140
16	94.0	150	166	182
18	119	189	210	231
19	132	211	233	257
20	147	234	259	285
22	178	283	313	345
24	211	336	373	411
26	248	395	437	482
28	288	458	507	559
32	376	598	662	730
35	450	716	792	873
36	476	757	838	924
38	530	843	934	1030
40	587	935	1040	1140
44	711	1130	1250	1380
45	743	1180	1310	1440
48	846	1350	1490	1640
51	955	1520	1680	1850
52	992	1580	1750	1930
56	1150	1830	2030	2240
60	1320	2100	2330	2570

TABLE C9

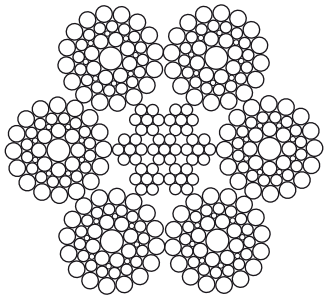
CLASS 6 × 36 WITH STEEL CORE

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	6 × 31WS–IWRC	1–6–6+6–12	72	12
	6 × 36WS–IWRC	1–7–7+7–14	84	14
	6 × 41WS–IWRC	1–8–8+8–16	96	16
	6 × 41F–IWRC	1–8–8–8F–16	96	16
	6 × 49WS–IWRC	1–8–8–8+8–16	96	16
	6 × 46WS–IWRC	1–9–9+9–18	108	18

Nominal rope diameter *(d)*	Approximate nominal length mass	Minimum breaking force		
		Grade 1770	Grade 1960	Grade 2160
mm	kg/100 m	kN	kN	kN
7	20.0	30.9	34.2	37.7
8	26.2	40.3	44.7	49.2
9	33.1	51.0	56.5	62.3
10	40.9	63.0	69.8	76.9
11	49.5	76.2	84.4	93.0
12	58.9	90.7	100	111
13	69.1	106	118	130
14	80.2	124	137	151
15	92.0	142	157	173
16	105	161	179	197
18	133	204	226	249
19	148	227	252	278
20	164	252	279	308
22	198	305	338	372
24	236	363	402	443
26	276	426	472	520
28	321	494	547	603
30	368	567	628	692
32	419	645	715	787
35	501	772	855	942
36	530	817	904	997
38	591	910	1010	1110
40	654	1010	1120	1230
44	792	1220	1350	1490
45	828	1280	1410	1560
48	942	1450	1610	1770
51	1060	1640	1810	2000
52	1110	1700	1890	2080
56	1280	1980	2190	2410
58	1390	2200	2440	2680
60	1470	2270	2510	2770
64	1730	2690	—	—
70	2080	3090	—	—
75	2360	3620	—	—

TABLE C10

CLASS LARGE DIAMETER, SIX STRANDED ROPE FOR EXCAVATOR PURPOSES

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	6 × 49SFS–IWRC	1–8–8F–16–16	96	16
	6 × 49SWS–IWRC	1–8–8–8+8–16	96	16
	6 × 55SF–IWRC	1–9–9F–18–18	108	18

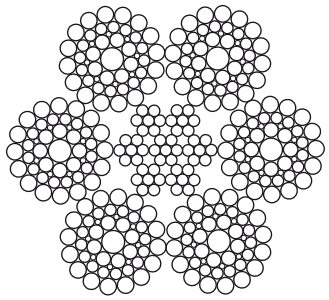
Nominal rope diameter *(d)* mm	Approximate nominal length mass kg/100 m	Minimum breaking force (see Notes) kN
64	1640	2500
67	1868	2740
70	2053	2990
73	2187	3250
80	2611	3900
83	2857	4200
85	2857	4410
95	3744	5510
102	4223	6350
111	4872	7520
114	5413	7930
120	5804	8930
127	6557	9840
143	8055	10910

NOTES:

1 The breaking force values above apply to ropes with bright or zinc-coated quality B wires where available. The values of breaking forces for ropes with a heavier mass of coating than quality B may be lower than those given above. Limitations apply to the availability of galvanized wire in the larger sizes required to manufacture these ropes.

2 The tensile grade of the rope is as specified by the manufacturer.

TABLE C11
CLASS LARGE DIAMETER, SIX STRANDED ROPE

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	6 × 49SFS–IWRC	1–8–8F–16–16	96	16
	6 × 49SWS–IWRC	1–8–8–8+8–16	96	16
	6 × 55SF–IWRC	1–9–9F–18–18	108	18

Nominal rope diameter *(d)*	Approximate nominal length mass	Minimum breaking force (see Notes)
mm	kg/100 m	kN
64	1730	2950
67	1910	3240
70	2080	3530
73	2280	3840
76	2470	4160
80	2680	4490
83	2900	4830
86	3130	5180
89	3380	5520
95	3870	6270
102	4400	6350
108	4960	7120
114	5570	7930
121	6200	8930
127	6870	9840
133	7410	9440
140	8110	10800
146	8870	12150
152	9680	13160

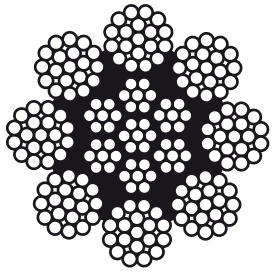
NOTES:

1 The breaking force values above apply to ropes with bright or zinc-coated quality B wires. The values of breaking forces for ropes with a heavier mass of coating than quality B may be lower than those given above.

2 The tensile grade of the rope is as specified by the manufacturer.

TABLE C12

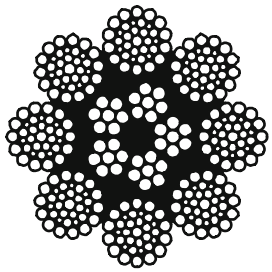
CLASS 8 × 19 WITH STEEL CORE

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	8 × 19S–IWRC	1–9–9	72	9
	8 × 21F–IWRC	1–5–5F–10	80	10
	8 × 26WS–IWRC	1–5–5+5–10	80	10
	8 × 19W–IWRC	1–6–6+6	96	12
	8 × 25F–IWRC	1–6–6F–12	96	12

Nominal rope diameter *(d)*	Approximate nominal length mass	Minimum breaking force		
		Grade 1770	Grade 1960	Grade 2160
mm	kg/100 m	kN	kN	kN
5	10.2	15.8	17.5	19.2
6	14.6	22.7	25.1	27.7
7	19.9	30.9	34.2	37.7
8	26.0	40.3	44.7	49.2
9	33.0	51.0	56.5	62.3
10	40.7	63.0	69.8	76.9
11	49.2	76.2	84.4	93.0
12	58.6	90.7	100	111
13	68.8	106	118	130
14	79.8	124	137	151
16	104	161	179	197
18	132	204	226	249
19	147	227	252	278
20	163	252	279	308
22	197	305	338	372
24	234	363	402	443
26	275	426	472	520
28	319	494	547	603
32	417	645	715	787
35	499	772	855	942
36	527	817	904	997
38	588	910	1010	1110
40	651	1010	1120	1230
44	788	1220	1350	1490
45	824	1280	1410	1560
48	938	1450	1610	1770
51	1060	1640	1810	2000
52	1110	1700	1890	2080
56	1280	1980	2190	2410
60	1470	2270	2510	2770

TABLE C13

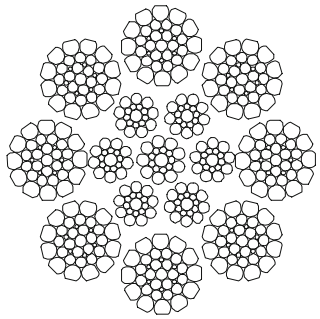
CLASS 8 × 36 WITH STEEL CORE

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	8 × 31WS–IWRC	1–6–6+6–12	96	12
	8 × 36WS–IWRC	1–7–7+7–14	112	14
	8 × 41WS–IWRC	1–8–8+8–16	128	16
	8 × 41F–IWRC	1–8–8–8F–16	128	16
	8 × 49WS–IWRC	1–8–8–8+8–16	128	16

Nominal rope diameter *(d)*	Approximate nominal length mass	Minimum breaking force		
		Grade 1770	Grade 1960	Grade 2160
mm	kg/100 m	kN	kN	kN
8	26.7	40.3	44.7	49.2
9	33.8	51.0	56.5	62.3
10	41.7	63.0	69.8	76.9
11	50.5	76.2	84.4	93.0
12	60.0	90.7	100	111
13	70.5	106	118	130
14	81.7	124	137	151
16	107	161	179	497
18	135	204	226	249
19	151	227	252	278
20	167	252	279	308
22	202	305	338	372
24	240	363	402	443
26	282	426	472	520
28	327	494	547	603
32	427	645	715	787
35	511	772	855	942
36	540	817	904	997
38	602	910	1010	1110
40	667	1010	1120	1230
44	807	1220	1350	1490
45	844	1280	1410	1560
48	961	1450	1610	1770
51	1080	1640	1810	2000
52	1130	1700	1890	2080
56	1310	1980	2190	2410
60	1500	2270	2510	2770

TABLE C14

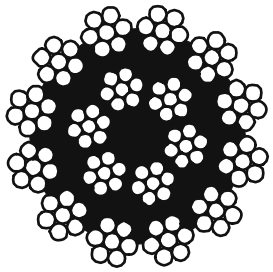
CLASS 8 × 36 COMPACTED WITH STEEL CORE FOR EXCAVATOR PURPOSES

Typical cross-section		Typical construction			
		Rope construction	Strand construction	Outer wires	
				Total	Per strand
		8 × 36WS–IWRC	1–7–7+7–14	112	14
		8 × 37SF–IWRC	1–6–6–6–6F–12	96	12
		8 × 43SW–IWRC	1–7–7–7+7–14	112	14
		8 × 49SF–IWRC	1–8–8–8–8F–16	128	16
Nominal rope diameter *(d)*	**Approximate nominal length mass**	**Minimum breaking force (see Note)**			
mm	**kg/100 m**	**kN**			
64	1800	2600			
70	2290	3200			
73	2470	3500			
80	3000	4200			
83	3200	4600			

NOTE: These ropes are ‘dual tensile grade’, as specified by the manufacturer.

TABLE C15

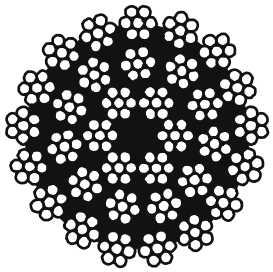
CLASS 18 × 7

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	17 × 7–FC	1–6	66	6
	18 × 7–FC	1–6	72	6

Nominal rope diameter *(d)*	Approximate nominal length mass	Minimum breaking force		
	Rope with FC centre	Grade 1770	Grade 1960	Grade 2160
mm	kg/100 m	kN	kN	kN
6	13.8	20.9	23.1	25.5
7	18.7	28.4	31.5	34.7
8	24.4	37.2	41.1	45.3
9	30.9	47.0	52.1	57.4
10	38.2	58.1	64.3	70.8
11	46.2	70.2	77.8	85.7
12	55.0	83.6	92.6	102
13	64.6	98.1	109	120
14	74.9	114	126	139
16	97.8	149	165	181
18	124	188	208	230
19	138	210	232	256
20	153	232	257	283
22	185	281	311	343
24	220	334	370	408
26	258	392	435	479
28	299	455	504	555
32	391	594	658	725
35	468	711	788	868
36	495	752	833	918
38	552	838	928	1020

TABLE C16

CLASS 34(M) × 7

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	34(M) × 7–FC	1–6	102	6
	34(M) × 7–WSC	1–6	102	6
	36(M) × 7–FC	1–6	108	6
	36(M) × 7–WSC	1–6	108	6

Nominal rope diameter *(d)*	Approximate nominal length mass		Minimum breaking force	
	Rope with FC centre	Rope with WSC centre	Grade 1770	Grade 2160
mm	kg/100 m	kg/100 m	kN	kN
10	39.0	40.1	56.3	62.3
11	47.2	48.5	68.1	75.4
12	56.2	57.7	81.1	89.8
13	65.9	67.8	95.1	105
14	76.4	78.6	110	122
16	99.8	103	144	160
18	126	130	182	202
19	141	145	203	225
20	156	160	225	249
22	189	194	272	302
24	225	231	324	359
26	264	271	380	421
28	306	314	441	489
32	399	411	576	638
35	478	491	690	764
36	505	520	729	808
38	563	579	813	900
40	624	642	901	997
44	755	776	1090	1210

TABLE C17

A1

CLASS 35(W) × 7

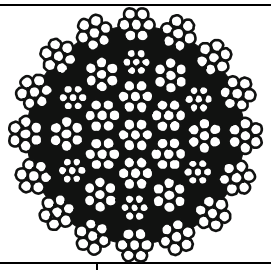
Typical cross-section		Typical construction			
		Rope construction	Strand construction	Outer wires	
				Total	Per strand
		35(W) × 7 40(W) × 7	1–6 1–6	96 108	6 6
Nominal rope diameter *(d)*	**Approximate nominal length mass**	**Minimum breaking force**			
		Grade 1770	**Grade 1960**	**Grade 2160**	
mm	**kg/100 m**	**kN**	**kN**	**kN**	
8	29.1	40.8	45.2	48.4	
9	36.8	51.6	57.2	61.2	
10	45.4	63.7	70.6	75.6	
11	54.9	77.1	85.4	91.5	
12	65.4	91.8	102	109	
13	76.7	108	119	128	
14	89.0	125	138	148	
16	116	163	181	194	
18	147	206	229	245	
19	164	230	255	273	
20	182	255	282	302	
22	220	308	342	366	
24	262	367	406	435	
26	307	431	477	511	
28	356	500	553	593	
32	465	652	723	774	
35	556	781	864	926	
36	588	826	914	980	
38	656	920	1020	1090	
40	726	1020	1130	1210	

TABLE C18

3 STRANDED ROPES FOR ROADSIDE SAFETY BARRIERS

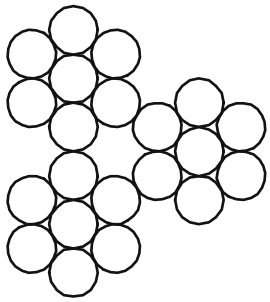
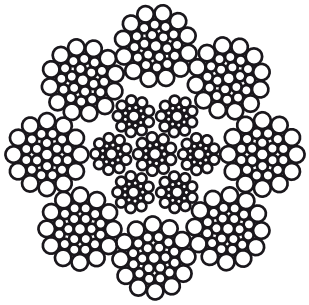
Typical cross-section		Typical construction			
		Rope construction	Strand construction	Outer wires	
				Total	Per strand
		3 × 7	1–6	18	6
Nominal rope diameter *(d)*	Approximate nominal length mass	Minimum breaking force			
		Grade 1220			
mm	kg/100 m	kN			
19	120	165.5			

TABLE C19

CLASS LARGE DIAMETER, EIGHT STRANDED ROPE FOR EXCAVATOR PURPOSES

Typical cross-section	Typical construction			
	Rope construction	Strand construction	Outer wires	
			Total	Per strand
	8 × 37SFS–IWRC	1–6–6F–12–12	72	12
	8 × 36SWS–IWRC	1–7–7+7–14	84	14
	8 × 43SFS–IWRC	1–7–7F–14–14	84	14

Nominal rope diameter *(d)* mm	Approximate nominal length mass kg/100 m	Minimum breaking force (see Notes) kN
64	1640	2500
67	1868	2740
70	2053	2990
73	2187	3250
80	2611	3900
83	2857	4200
85	2857	4410
95	3744	5510
102	4223	6350
111	4872	7520
114	5413	7930
120	5804	8930
127	6557	9840
143	8055	10910

NOTES:

1 The breaking force values above apply to ropes with bright or zinc-coated quality B wires where available. The values of breaking forces for ropes with a heavier mass of coating than quality B may be lower than those given above. Limitations apply to the availability of galvanized wire in the larger sizes required to manufacture these ropes.

2 The tensile grade of the rope is as specified by the manufacturer.

APPENDIX D

CALCULATION OF MINIMUM BREAKING FORCE FOR ROPES LISTED IN THE TABLES OF APPENDIX C

(Normative)

The minimum breaking force (F_{min}), expressed in kilonewtons, shall be calculated using the following equation:

$$F_m = \frac{d^2 \times R_r \times K}{1000} \quad \ldots D1$$

where

d = nominal diameter of the rope, in millimetres

R_r = rope grade, in newtons per square millimetre

K = minimum breaking force factor for a given rope class

The minimum breaking force factors for ropes covered by Tables C1 to C17, Appendix C, are given in Table D1.

TABLE D1

MINIMUM BREAKING FORCE FACTORS

Class	Minimum breaking force factor (K)
6 × 7 with fibre core (see Table C1)	0.332
6 × 7 with steel core (see Table C2)	0.359
6 × 24FC with fibre core (see Table C3)	0.286
6 × 37M with fibre core (see Table C4)	0.295
6 × 19M with fibre core (see Table C5)	0.307
6 × 19 with steel core (see Table C6)	0.356
6 × 19M with steel core (see Table C7)	0.332
6 × 36 with fibre core (see Table C8)	0.330
6 × 36 with steel core (see Table C9)	0.356
8 × 19 with steel core (see Table C12)	0.356
8 × 36 with steel core (see Table C13)	0.356
18 × 7 (see Table C15)	0.328
34(M) × 7 (see Table C16)	0.318
35(W) × 7 (see Table C17)	0.360 (rope grade ≤1960)
35(W) × 7 (see Table C17)	0.350 (rope grade >1960)

APPENDIX E

TESTS ON WIRES TAKEN FROM THE ROPE

(Normative)

E1 GENERAL

If tests on wires are required to be carried out, these are usually in respect of diameter, tensile strength and torsions; and, when applicable, zinc coating.

For the purposes of evaluating the test results, the manufacturer should indicate the nominal dimensions and tensile strength grades of the wires.

The sample selected should be of sufficient length to allow for retest.

NOTE: These provisions do not apply to compacted strand ropes and compacted (swaged) ropes.

E2 SAMPLING

For each layer of strands, including those in the core, one strand of each construction within that layer shall be selected and the wires tested. If there are more than eight strands of the same diameter and construction in one layer, the wires from two strands of that diameter and construction shall be tested.

Unless specified otherwise, the samples of wires taken for tests shall not include filler or centre wires.

E3 TEST METHODS AND ACCEPTANCE CRITERIA

E3.1 General

For each requirement, a maximum of 5% of wires tested, rounded up to the nearest whole number of wires, shall be permitted to lie outside the values specified.

When the same wire fails in more than one test (e.g., torsion and tensile) this is counted as one failure.

E3.2 Diameter

When wire diameters are measured in accordance with ISO 2232, 5% of the wires may exceed by up to 50% the applicable diameter tolerance specified in AS 1394.

E3.3 Tensile strength

When tested in accordance with AS 1931, the measured values shall be in accordance with the values in AS 1394 with an expanded tolerance of 50 MPa at the lower end.

For ropes with shaped (e.g., triangular) strands, the expanded tolerance at the lower end shall be equivalent to 5% of the tensile strength grade of the wire.

NOTE: Measured wire tensile strength is R_m ratio between the maximum force obtained in a tensile test and the cross-sectional area of the test piece, expressed in newtons per square millimetre.

E3.4 Torsion

A length of $100d$ for the test piece between grips is preferred. If this length cannot be adopted, an alternative length shall be chosen at the wire manufacturer's discretion. In this case, the number of torsions that the wire shall withstand shall be proportional to the numbers specified for a test length of $100d$.

For ropes with round strands, when tested in accordance with AS 2505.5, the measured values of round wires of 0.5 mm diameter and larger shall be at least 85% of the values specified in AS 1394, rounded down to the next whole number.

For ropes with shaped strands with more than one layer of round wires in the strands, the values resulting from the above for round wires shall be reduced by one torsion each.

For ropes with shaped strands with only one layer of round wires in the strands, the values resulting from the above for round wires shall be reduced by two torsions each.

For test on wires less than 0.5 mm, see Paragraph E3.5.

E3.5 Knot

This test shall apply to wires smaller than 0.5 mm diameter in substitution for the torsion test.

Each single wire with one simple knot shall withstand without breaking a force of at least 45% of the force corresponding to the tensile strength grade.

E3.6 Coating of wires

When measured in accordance with AS/NZS 4534, the reduction of mass of zinc or Zn 95/Al 5 coating from the pre-spin (before ropemaking) minimum values shall be not more than the values given in Table E1.

TABLE E1

PERMISSIBLE REDUCTION OF MINIMUM MASS OF ZINC COATING OF WIRES FOR STRANDED ROPES

Minimum mass before ropemaking	Reduction in mass of zinc after ropemaking
g/m^2	g/m^2
<40	2
40 to <80	4
80 to <120	6
120 to <160	8
160 to <200	10
200 to <300	15
300 to <400	20
>400	25

APPENDIX F

ROPE GRADE EQUIVALENTS

(Informative)

Table F1 gives guidance on equivalent rope grades.

TABLE F1

COMPARISON OF ROPE GRADES—FOR GUIDANCE ONLY

Rope grade designation (American Petroleum Institute)	Equivalent rope grade (MPa)
IP	1770
EIP	1960
EEIP	2160

APPENDIX G

STANDARDS RELEVANT TO THE APPLICATION OF STEEL WIRE ROPES

(Informative)

The following standards may be relevant in the application of steel wire ropes:

AS	
1222	Steel conductors and stays
1222.1	Part 1: Bare overhead—Galvanized (SC/GZ)
1222.2	Part 2: Bare overhead—Aluminium clad (SC/AC)
1666	Wire-rope slings
1666.1	Part 1: Product specification
1666.2	Part 2: Care and use
2759	Steel wire ropes—Use, operation and maintenance
2841	Galvanized steel wire strand
3607	Conductors—Bare overhead, aluminium and aluminium alloy—Steel reinforced
AS/NZS	
4812	Non-destructive examination and discard criteria for wire ropes in mine winding systems
AS/NZS/ ISO	
9001	Quality management systems—Requirements
ISO	
2232	Round drawn wire for general purpose non-alloy steel wire ropes and for large diameter steel wire ropes—Specifications
2408	Steel wire ropes for general purposes—Minimum requirements
2532	Steel wire ropes—Vocabulary
2701	Drawn wire for general purpose non-alloy steel wire ropes—Terms of acceptance
3108	Steel wire ropes for general purposes—Determination of actual breaking load
4101	Drawn steel wire for elevator ropes—Specifications
4344	Steel wire ropes for lifts—Minimum requirements
6984	Round non-alloy steel wires for stranded wire ropes for mine hoisting—Specifications
9000	Quality management systems—Fundamentals and vocabulary
9975	Round non-alloy steel wires for locked coil mine winding ropes—Specifications
10425	Steel wire ropes for the petroleum and natural gas industries—Minimum requirements and terms of acceptance
12076	Steel wire ropes—Determination of the actual modulus of elasticity
17893	Steel wire ropes—Vocabulary, designation and classification
21669	Steel wire ropes—Determination of rotational properties

APPENDIX H
INDUSTRY RELEVANT TERMS
(Informative)

The following additional relevant industry terms are defined in ISO 17893:

approximate outer wire diameter

calculated measured aggregate breaking force
calculated measured breaking force
calculated metallic cross-sectional area
calculated value

dimension of outer round wire
dimension of round strand
dimension of round wire
dimension of shaped wire
dimensions of covered flat rope
dimensions of covered round rope
dimensions of flat rope
dimensions of flat rope

electro-mechanical rope

flat ribbon strand
flat rope

manufacturer’s design value
measured metallic cross-sectional area
measured partial spinning loss
measured partial spinning loss factor
measured reduced aggregate breaking force
measured total spinning loss factor
measured value
minimum aggregate breaking force
minimum value
multi-strand rope (superseded)

nominal metallic cross-sectional area
nominal metallic cross-sectional area factor
nominal rope length mass
nominal value
non-rotating rope (superseded)

outer wire diameter factor
oval strand

production length

reduced minimum aggregate breaking force
reduced value
rope length mass factor

serving strand
serving wire
spring lay
stitching strand
stitching wire
strand clearance

BIBLIOGRAPHY

ISO 2408 Steel wire ropes for general purposes—Minimum requirements

ISO 17893 Steel wire ropes—Vocabulary, designation and classification

ALPHABETICAL INDEX

AMENDMENT CONTROL SHEET

AS 3569—2010

Amendment No. 1 (2012)

REVISED TEXT

SUMMARY: This Amendment applies to Table C17.

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NOTES

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