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**Non-parallel steel wire and cords for  
tyre reinforcement**

*Fils d'acier et cordes non parallèles pour le renfort de pneumatiques*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 17, *Steel wire rod and wire products*.

This second edition cancels and replaces the first edition (ISO 17832:2009), which has been technically revised.

The following changes have been made:

- tensile strength for UT, ST and NT constructions has been updated;
- HI construction has been added;
- the tolerance for lay length has been narrowed from “±10 %” to “±5 %”;
- the tolerance of residual torsion for HE construction has been narrowed from ±4 torsion/6 m to ±3 torsion/6 m;
- the tolerance for spool length has been narrowed;
- the weld breaking load for HT, ST and UT constructions has been increased.

# Non-parallel steel wire and cords for tyre reinforcement

## 1 Scope

This document specifies the definition and requirements of non-parallel steel wire and cords for tyre reinforcement.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3951-1, *Sampling procedures for inspection by variables — Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL*

ISO 3951-2, *Sampling procedures for inspection by variables — Part 2: General specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection of independent quality characteristics*

ISO 3951-3, *Sampling procedures for inspection by variables — Part 3: Double sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3951-5, *Sampling procedures for inspection by variables — Part 5: Sequential sampling plans indexed by acceptance quality limit (AQL) for inspection by variables (known standard deviation)*

## 3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

### 3.1 filament

metal fibre with a metallic alloy coating used as an individual element in a *strand* (3.2) or *cord* (3.3)

### 3.2 strand

group of *filaments* (3.1) combined together to form a unit product for further processing

### 3.3 cord

formed structure composed of two or more *filaments* (3.1) when used as an end product, or a combination of *strands* (3.2) or filaments and strands

#### 3.3.1 single-strand cord

*cord* (3.3) formed by twisting two or more *filaments* (3.1) together

### 3.3.2

#### **M+N type cord**

*cord* (3.3) formed by twisting a number of non-concentric *filaments* (3.1) around a number of parallel filaments

Note 1 to entry: The cross-section is not round and varies along the length.

### 3.3.3

#### **layer cord**

*cord* (3.3) formed by adding layers around a core

Note 1 to entry: The layers can be filaments or strands.

### 3.3.4

#### **multi-strand cord**

*cord* (3.3) formed by twisting two or more *strands* (3.2) together

### 3.4

#### **wrap**

*filament* (3.1) wound helically around a steel *cord* (3.1)

### 3.5

#### **direction of lay**

helical disposition of the components of a *strand* (3.2) or cord

Note 1 to entry: The strand or cord has an "S" or left-hand lay, when held vertically, if the spirals around the central axis of the strand or cord conform in direction of slope to the central portion of the letter "S".

Note 2 to entry: The strand or cord has a "Z" or right-hand lay if the spirals conform in direction of slope to the central portion of slope of the letter "Z".

### 3.6

#### **length of lay**

axial distance required to make a 360° revolution of any element in a *strand* (3.2) or in a *cord* (3.3)

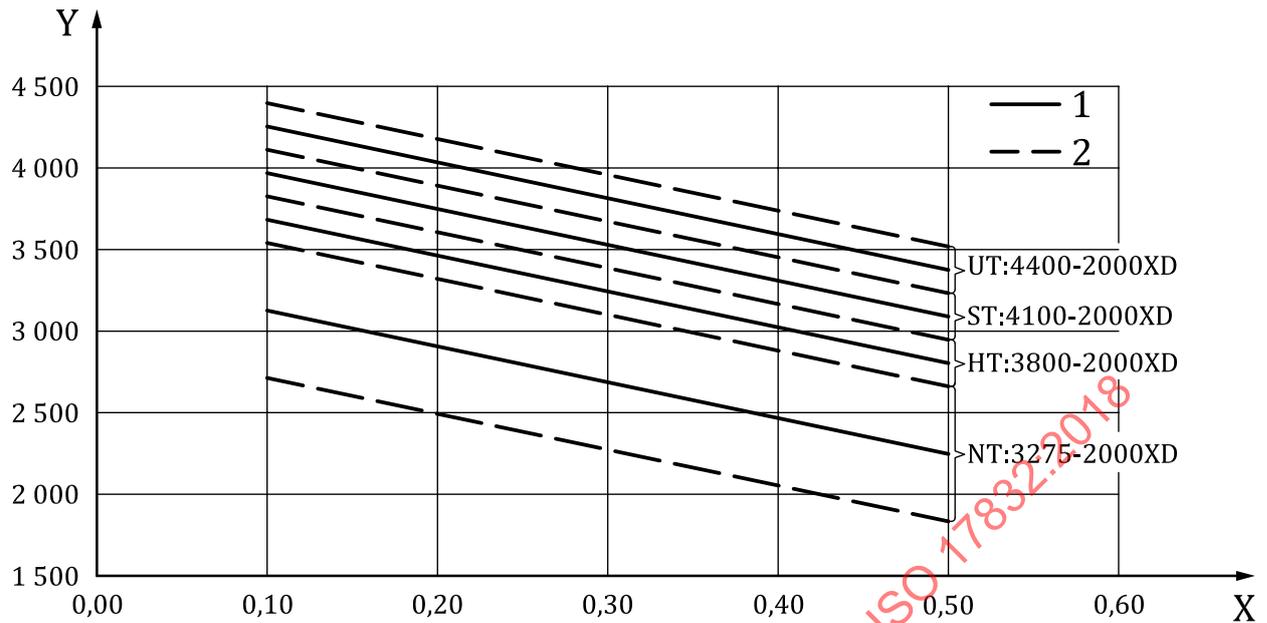
Note 1 to entry: The length of lay is expressed in millimetres.

## 4 Classification

### 4.1 Classification based on tensile strength

Steel cord is supplied in levels of tensile strength (see [Figure 1](#)), designated as follows:

- NT: normal standard (or regular) tensile strength cord;
- HT: high tensile strength cord;
- ST: super tensile strength cord;
- UT: ultra tensile strength cord.

**Key**

X	filament diameter, mm	1	solid line indicates target value
Y	filament tensile strength, MPa	2	dashed line indicates tolerance range

NOTE The target value is determined by agreement between the manufacturer and the purchaser.

**Figure 1 — Tensile strength levels**

[Figure 1](#) gives the tensile strength levels of wet-drawn filaments. The cord breaking load is calculated from the filament number, lay length and cabling loss. For example, cord construction 2x0,30ST 14/S is calculated by [Formula \(1\)](#):

$$F = n \times (f \times \cos \alpha) \times (1 - C) \quad (1)$$

where

$F$  is the breaking load of cord construction 2x0,30ST 14/S, in mega pascals;

$f$  is the breaking load of 0,30ST, in mega pascals;

$\alpha$  is the cabling angle, in degrees;

$n$  is the number of filament;

$C$  is the cabling loss on tensile strength (e.g. 4 %).

## 4.2 Classification based on cord structure

The main classification based on cord structure is categorized by the following four structures:

- single-strand cords;
- M+N type cords;
- layer cords;
- multi-strand cords.

### 4.3 Classification based on cord type

The main classification based on cord type is categorized by the following four types:

- HE: high-elongation cord;
- OC: open cord;
- CC: compact cord;
- WC: wavy cord, a cord with filaments preformed in 2 or 3 dimensional wavy shape in order to improve rubber penetration;
- HI: high impact cord.

Another detailed classification may be used if there is mutual agreement between the manufacturer and the purchaser.

## 5 Designation and ordering

A tyre cord construction is normally defined by

- cord structure,
- cord tensile strength,
- cord type,
- length and direction of lay, and
- coating type.

### 5.1 Cord structure

The description of the cord structure follows the sequence of manufacture of the cord, i.e. starting with the innermost strand or wire and moving outwards.

The full description of the cord structure is given by the following formulas:

$$(N \times X) \times D + (N \times X) \times D + (N \times X) \times D + D, \text{ or}$$

$$(N \times X) \times D / (N \times X) \times D + (N \times X) \times D + D \text{ for compact cords, and}$$

$$(N \times N) \times D + D$$

where

$N$  is the number of strands;

$X$  is the number of filaments;

$D$  is the nominal diameter of wires, expressed in millimetres.

EXAMPLE 1  $(1 \times 3) \times 0,22 + (1 \times 9) \times 0,22 + (1 \times 15) \times 0,22 + 0,15$ .

When  $N$  or  $F$  equals 1, they should not be included.

EXAMPLE 2  $3 \times 0,22 + 9 \times 0,22 + 15 \times 0,22 + 0,15$ .

If the diameter  $D$  is the same for two or more parts in sequence, it shall only be stated at the end of the sequence.

The diameter of the spiral wrap shall always be stated separately.

EXAMPLE 3  $3 + 9 + 15 \times 0,22 + 0,15$ .

When the innermost strand or wire is identical to the adjacent strand or wires, the formula may be simplified by stating only the sum of the identical components and brackets need not be used.

EXAMPLE 4  $0,22 + 6 \times 0,22 + 6 \times (0,22 + 6 \times 0,22)$  becomes  $7 \times 7 \times 0,22$ .

## 5.2 Cord tensile strength

There are four levels of tensile strength: NT, HT, ST and UT as defined in [4.1](#). The tensile class of the spiral wrap is not governed by the tensile class levels.

## 5.3 Cord type

See [4.3](#)

## 5.4 Length and direction of lay

The sequence or order in the designation follows the sequence of manufacturing, i.e. starting with the innermost strand and moving outwards.

EXAMPLE 1

$3 + 9 + 15 \times 0,175 + 0,15$

5/10/16/3.5 SSZS

5 S: lay length and direction of the strand  $3 \times 0,175$

10 S: lay length and direction of the strand  $+ 9 \times 0,175$

16 Z: lay length and direction of the strand  $+ 15 \times 0,175$

3,5 S: lay length and direction of the spiral wrap

EXAMPLE 2

$7 \times (3 + 9 + 15 \times 0,175) + 0,20$

(5/10/16)/(5/10/16)/38/5 SSS/ZZZ/S/Z

5 S: lay length and direction of the innermost strand  $3 \times 0,175$

10 S: lay length and direction of the innermost strand  $+ 9 \times 0,175$

16 S: lay length and direction of the innermost strand  $+ 15 \times 0,175$

5 Z: lay length and direction of the adjacent strand  $3 \times 0,175$

10 Z: lay length and direction of the adjacent strand  $+ 9 \times 0,175$

16 Z: lay length and direction of the adjacent strand  $+ 15 \times 0,175$

38 S: lay length and direction of the cable

5 Z: lay length and direction of the spiral wrap

## 5.5 Coating type

There are two classic types of brass coating: high-copper coating and normal copper coating, as listed in [Table 2](#). More advanced metallic alloy coatings such as Cu-Zn-Co are possible.

## 6 Requirements

### 6.1 General

Specified tests are mainly conducted in accordance with internationally agreed methods for steel tyre cords, such as ASTM D2229-10, ASTM D2969-04, BISFA, JIS G 3510, etc.

### 6.2 Dimensions, mass and tolerances

#### 6.2.1 Diameter of cord

The diameter of the circumscribed circle of cord, in millimetres, and detailed requirements are listed in [Table 5](#).

#### 6.2.2 Linear density

The linear density, i.e. the mass of a 1 m length of cord, in grams per metre (g/m), and detailed requirements are listed in [Table 5](#).

#### 6.2.3 Tolerances

The tolerance of the cord length shall conform to [Table 1](#).

Tolerance of filament diameter:  $\pm 10 \mu\text{m}$ .

Tolerance of lay length:  $\pm 5 \%$ .

Tolerance of residual torsion of cord:  $\pm 3$  torsions/6 m in general.

**Table 1 — The tolerance of the cord length**

Cord length, <i>L</i> m	Tolerance <sup>a</sup> %
$L \leq 2\,000$	$\pm 0,75 \%$
$> 2\,000$ approximately 8 000	$\pm 0,50 \%$
$> 8\,000$	$\pm 0,25 \%$
<sup>a</sup> With a minimum of $\pm 10$ m.	

### 6.3 Welds and splices

Continuous lengths shall be supplied as follows:

Cord may be welded and shall withstand a minimum load as follows:

- for NT,HT cord: 40 % of the minimum breaking load of the cord;
- for ST,UT cord and off-the-road cords: 35 % of the minimum breaking load of the cord.

An additional bending test is needed for the control of the welds.

In the case of layer cords, splicing or a simple knot filament connection can be used in lieu of welds, except in the outer-most layer.

The increase in diameter of the finished weld or splicing shall not exceed the cord diameter by more than 10 % (or 20 %, if agreed between the manufacturer and the purchaser).

The number of cord welds shall not exceed:

- 3 per spool type BS40 or BS60;
- 6 per spool type BS80;
- 30 % of spools per box or delivery lot by agreement between the manufacturer and the purchaser (based on 72 BS40/60 spools per box or 36 BS80 spools per box).

The dimensions of typical spool types are shown in [Table 3](#).

## 6.4 Mechanical properties

### 6.4.1 Breaking load and elongation at fracture

A specimen of cord is clamped in a tensile-testing apparatus under a defined pre-tension and is subjected to a constant rate of extension until the cord breaks; if the specimen has a spiral wrap, it shall be removed from the length of the specimen in contact with the clamps.

Only clamps which do not cause fractures in the vicinity of the clamped area shall be used.

### 6.4.2 Structural elongation

Structural elongation (e.g. part load elongation at 2.5 N to 50 N) is the increase in length between defined tension levels, expressed as a percentage of the original gauge length.

## 6.5 Technological properties

### 6.5.1 Straightness

The steel cord sample is put on a smooth surface on which two parallel lines 6 m long and 75 mm apart are marked. The steel cord sample should stay between the two lines.

### 6.5.2 Arc height

After releasing the end of the specimen used for the residual torsion determination, the arc height, expressed in millimetres, at a specified inter-distance shall be measured.

The specified inter-distance may be 300 mm or 400 mm.

### 6.5.3 Residual torsion

One end of a specified length (normally 6 m) of cord is allowed to turn freely: the number of revolutions is counted as residual torsion and the direction is noted.

### 6.5.4 Flare

The flare of the end of the specimen should not be more than the length of the lay or the amount which might influence the process-ability and/or the laboratory test, such as the adhesion test.

### 6.5.5 Steel cord elasticity

Steel cord elasticity, expressed as a percentage, is the degree to which a cord reverts to its original form after having been subjected to a specific bending deformation.

### 6.5.6 Rubber penetration

Determination of the degree of rubber penetration shall be done on a rubber-embedded steel cord sample.

## 6.6 Brass coating

The wire should be uniformly and continuously coated with brass. The thickness and the composition of the coating are listed in [Table 2](#).

### 6.6.1 Mass fraction of brass coating

The mass of brass coating is the mass of brass per unit of sample, expressed in grams per kilogram.

### 6.6.2 Thickness of coating

The relationship between the thickness ( $t$ ) and the mass of brass coating ( $w$ ) is expressed in [Formula \(2\)](#):

$$t = 0,235 \times w \times d \quad (2)$$

where

- $t$  is the thickness of the coating, in micrometres ( $\mu\text{m}$ );
- $d$  is the diameter of the filament, in millimetres (mm);
- $w$  is the mass of brass coating, in grams per kilogram (g/kg).

### 6.6.3 Composition of brass

The mass fraction of copper in the brass coating is expressed as a percentage (see [Table 2](#)).

**Table 2 — Thickness and copper mass fraction of brass coating**

Type of coating	Diameter of filament ( $d$ ) mm	Coating mass ( $w$ ) g/kg	Thickness ( $t$ ) $\mu\text{m}$	Mass fraction of copper in brass %
High-copper coating	All diameters	$5 \pm 1,5$		$67,5 \pm 2,5$
Normal copper coating	$d < 0,27$		$0,20 \pm 30 \%$	$63,5^a \pm 2,5^b$
	$0,27 \leq d \leq 0,32$		$0,24 \pm 30 \%$	$63,5^a \pm 2,5^b$
	$0,32 < d$		$0,30 \pm 30 \%$	$63,5^a \pm 2,5^b$
<sup>a</sup> For a normal copper coating, the mean value may be 63 or 64, depending on the purchaser's specification. <sup>b</sup> For a normal copper coating, the tolerance may be $\pm 3,0$ , depending on the purchaser's specification.				

## 6.7 Adhesion force

The test method used shall be agreed between the manufacturer and the purchaser. The rubber compound used shall be provided by the purchaser, together with relevant information about vulcanization.

## 6.8 Constructions and properties

The main constructions of the steel cord, the typical mechanical properties and the dimensions including the linear density, in grams per metre (g/m), are shown in [Table 5](#).

However, the values of mechanical properties and dimensions stated in [Table 5](#) may be changed in accordance with an agreement between the manufacturer and the purchaser.

The construction not stated in [Table 5](#) may be manufactured in accordance with an agreement between the manufacturer and the purchaser. In this case, the mechanical properties and dimensions shall be decided in accordance with an agreement between the manufacturer and the purchaser.

## 7 Sampling

For variables, ISO 3951-1, ISO 3951-2, ISO 3951-3 and ISO 3951-5 shall be used. For attributes, ISO 2859-1 shall be used.

## 8 Packing

### 8.1 General

The product shall be packed adequately to ensure safe transportation, handling and correct arrival conditions in the purchaser's warehouse. In that respect, the necessary precautions to avoid any damage, deterioration, contamination of the product should be taken.

The shelf-life should be 6 months minimum and the humidity should be less than 30 %. A stricter humidity threshold may be agreed upon between the manufacture and the purchaser.

All units are provided with a desiccant and a humidity indicator. Cartons to be shipped can be stored for 6 months inside a warehouse where the combination of temperature and humidity does not lead to condensation. It is recommended to condition the units at ambient temperature before they are opened.

If either shelf-life or humidity are exceeded, adhesion should be retested.

### 8.2 Spools

Tire cord is wound on metal spools, as specified in [Figure 2](#) and [Table 3](#).

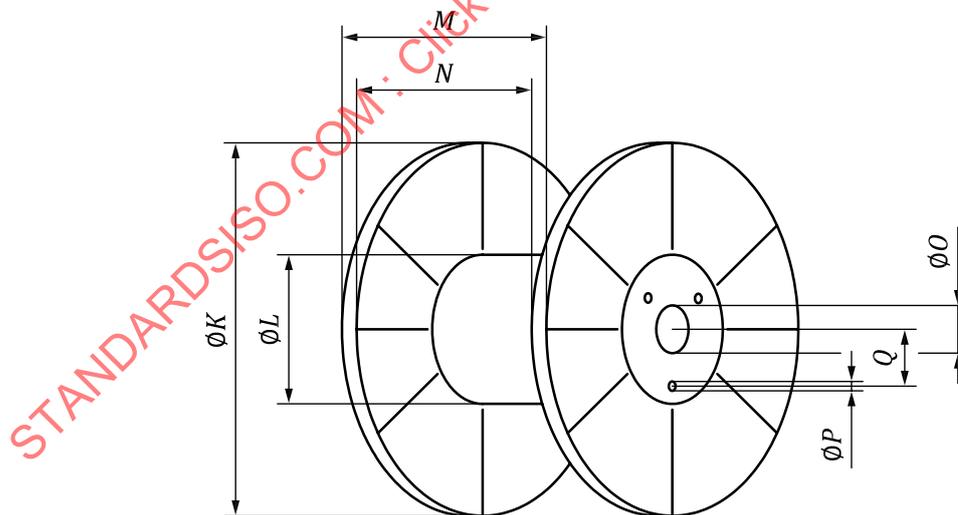


Figure 2 — Spool dimension

**Table 3 — Examples of dimensions and mass in typical spools**

Symbol	Dimension and mass		Type			
			BS40	BS60	BS80/17	BS80/33
K	Diameter of flange	(mm)	255	255	255	255
L	Diameter of barrel	(mm)	117	117	117	177
M	Overall width	(mm)	167	167	329	329
N	Traverse	(mm)	153	153	315	315
O	Bore diameter	(mm)	17	33	17	33
P	Number × diameter of driver-hole	(mm)	3 × 13	3 × 13	3 × 13	3 × 13
Q	Distance driver-hole/bore	(mm)	38	43	2/38 + 1/43	43
Approximate mass		(kg)	1,85	1,90	2,40	2,50
Approximate cord capacity		(kg)	18	18	36	36

### 8.3 Packaging

The tire cord spools are packed in a waterproof carton strapped to a pallet in units of approximately 1 300 kg net mass. Dimensions of one unit (including pallet) are 1 080 mm (length) × 810 mm (width) × 1 200 mm (height). The pallet is made of wood or plastic. Some internationally recognized packaging styles are listed in [Table 4](#) and [Figure 3](#).

**Table 4 — Example of packaging**

Type of spools	Composition	Number of spools	Approximate tare without pallet kg
BS40	4 × 3 × 6	72	157
BS60	4 × 3 × 6	72	161
BS80/17 to BS80/33	4 × 3 × 3	36	113



**a) The appearance**



**b) The internal display**

**Figure 3 — Example of packaging**

Table 5 — Examples of constructions and mechanical properties of the steel cord

Cord construction	Type	Lay length mm	Lay direction	Breaking load, N						Diameter mm		Linear density g/m		Elongation at break %		
				NT		HT		ST		UT		Max.	Aim		Max.	Aim
				Min.	Aim	Min.	Aim	Min.	Aim	Min.	Aim					
0,17+5 × 0,215+10 × 0,235	CC	15	Z	/	/	/	/	2 225	2 318	/	/	1,12	1,07	5,33	5,08	/
0,20+18 × 0,175	CC	12,5	Z	1 210	1 280	1 385	1 470	1 520	/	1 635	1 721	0,95	0,90	3,91	3,71	/
0,20+18 × 0,175	CC	10	Z	1 230	/	1 440	1 500	1 520	1 600	/	/	0,95	0,90	3,85	3,66	/
0,22+18 × 0,20	CC	12,5	Z	1 510	1 600	1 805	1 900	2 010	/	/	/	1,07	1,02	5,09	4,84	/
0,22+6+12 × 0,20	/	6,3/12,5	ZZ	/	/	1 775	1 880	2 010	2 094	/	/	1,07	1,02	5,12	4,86	/
0,25+18 × 0,22	CC	16	Z	1 805	1 920	2 170	2 284	/	/	/	/	1,19	1,13	6,16	5,85	/
0,25+6+12 × 0,225	/	7,5/16	ZZ	/	/	2 225	2 318	2 580	2 688	/	/	1,21	1,15	6,46	6,14	/
0,25+6+12 × 0,225	/	8/16	ZZ	/	/	2 225	2 318	2 580	2 688	/	/	1,19	1,13	6,37	6,05	/
0,315+6 × 0,30	/	16	S	/	/	1 360	1 432	1 583	1 666	/	/	0,97	0,92	4,20	3,99	/
0,34+6 × 0,34	/	17	S	/	/	1 840	1 937	/	/	/	/	1,19	1,13	5,29	5,03	/
0,365+6 × 0,35	/	18	S	/	/	1 860	1 958	2 053	2 161	/	/	1,13	1,08	5,71	5,42	/
0,37+6 × 0,32	/	16	S	/	/	/	/	1 890	1 989	/	/	1,07	1,02	4,95	4,71	/
12 × 0,20+0,15	CC	12,5/3,5	SZ	996	/	/	/	/	/	/	/	1,16	1,10	3,34	3,17	/
12 × 0,22	CC	12,5	S	1 170	1 250	1 360	1 432	/	/	/	/	0,96	0,91	3,83	3,64	/
12 × 0,22+0,15	CC	12,5/3,5	SZ	1 170	1 250	1 360	1 432	/	/	/	/	1,24	1,18	4,04	3,84	/
12 × 0,22+0,15	CC	12,5/5	SZ	/	/	1 330	1 420	/	/	/	/	1,24	1,18	4,02	3,82	/
2 × 0,25	/	14	S	/	/	/	/	/	/	350	370	0,53	0,50	0,81	0,77	/
2 × 0,28	/	14	S	/	/	/	/	396	417	432	455	0,59	0,56	1,02	0,97	/
2 × 0,30	/	14	S	325	355	405	445	445	470	485	511	0,63	0,60	1,18	1,12	/
2 × 0,30	/	16	S	/	/	/	/	/	/	488	514	0,63	0,60	1,18	1,12	/
2+1 × 0,25	/	∞/11	-S	/	/	425	447	483	508	520	/	0,68	0,63	1,22	1,16	/
2+1 × 0,28	/	∞16	-S	450	485	515	555	550	595	/	/	0,76	0,70	1,55	1,47	/
2+1 × 0,28	/	∞14	-S	460	/	510	537	588	619	/	/	0,77	0,71	1,53	1,46	/
2+1 × 0,30	/	∞16	-S	490	530	615	660	650	700	/	/	0,81	0,75	1,77	1,68	/
2+1 × 0,30	/	∞14	-S	520	/	610	642	670	705	/	/	0,81	0,75	1,76	1,67	/
2+2 × 0,25	/	∞14/14	-SS	490	530	570	605	630	663	/	/	0,70	0,65	1,63	1,55	/
2+2 × 0,28	/	∞16/16	-SS	610	660	685	740	784	825	/	/	0,79	0,73	2,04	1,94	/

Table 5 (continued)

Cord construction	Type	Lay length mm	Lay direction	Breaking load, N												Diameter mm		Linear density g/m		Elongation at break %
				NT			HT			ST			UT			Max.	Aim	Max.	Aim	
				Min.	Aim		Min.	Aim		Min.	Aim		Min.	Aim						
2+2 x 0,30	/	∞16/16	SS	660	715	825	870	880	926	/	/	/	0,84	0,78	2,35	2,23	/			
2+2 x 0,32	/	∞16/16	SS	745	805	890	937	1 000	1 053	/	/	/	0,90	0,83	2,71	2,57	/			
2+2 x 0,35	/	∞16/16	SS	880	950	980	1 060	1 175	1 237	1 275	1 342	/	1,02	0,94	3,21	3,05	/			
2+2 x 0,38	/	∞16/16	SS	1 000	1 080	1 165	1 260	/	/	/	/	/	1,08	1,00	3,79	3,60	/			
2+3 x 0,30	/	∞16	S	/	/	1 010	1 063	1 110	1 168	/	/	/	0,97	0,90	2,94	2,79	/			
2+4 x 0,17	/	∞10	S	/	/	/	/	/	/	475	500	/	0,52	0,48	1,14	1,08	/			
2+4 x 0,22	/	∞14	S	/	/	655	689	/	/	/	/	/	0,73	0,68	1,91	1,81	/			
2+7 x 0,22	/	6,3/12,5	SS	825	920	1 010	1 063	1 090	/	/	/	/	0,87	0,83	2,88	2,74	/			
2+7 x 0,22+0,15	/	6,3/12,5/5	SSZ	825	920	1 010	1 063	1 090	/	/	/	/	1,13	1,08	3,05	2,90	/			
2+7 x 0,25	/	7/14	SS	/	/	1 285	1 353	1 450	1 526	/	/	/	1,03	0,95	3,72	3,53	/			
2+7 x 0,26	/	7,5/15	SS	/	/	1 340	1 411	1 531	1 612	/	/	/	1,13	1,05	4,00	3,80	/			
2+7 x 0,28	/	8/16	SS	1 380	/	1 530	1 635	1 765	/	/	/	/	1,11	1,06	4,68	4,45	/			
2+7 x 0,28+0,15	/	8/16/3,5	SSZ	1 380	/	1 530	1 635	1 765	/	/	/	/	1,44	1,33	4,88	4,64	/			
2+7 x 0,30	/	8/16	SS	/	/	1 770	1 863	2 005	2 111	/	/	/	1,25	1,16	5,35	5,08	/			
2+7 x 0,34	/	8/18	SS	/	/	2 235	2 353	/	/	/	/	/	1,45	1,34	6,87	6,53	/			
2+8 x 0,30	/	8/16	SS	/	/	2 025	2 132	/	/	/	/	/	1,31	1,21	6,00	5,70	/			
3 x 0,15+6 x 0,27	/	9/10	ZS	1 000	/	/	/	/	/	/	/	/	0,89	0,85	3,34	3,17	/			
3 x 0,175+6 x 0,30	/	9,5/15,5	ZS	/	/	1 400	1 474	/	/	/	/	/	1,03	0,98	4,16	3,95	/			
3 x 0,175+6 x 0,32	/	9,5/15,5	ZS	1 380	/	1 540	1 621	/	/	/	/	/	1,09	1,04	4,65	4,42	/			
3 x 0,20/9 x 0,175	CC	10	S	800	855	950	1 020	1 050	/	1 150	1 211	1 150	0,79	0,75	2,62	2,49	/			
3 x 0,20/9 x 0,175+0,15	CC	10/5	SZ	800	855	950	1 020	1 050	/	/	/	/	1,07	1,02	2,81	2,67	/			
3 x 0,20/9 x 0,175+0,15	CC	10/3,5	SZ	835	/	950	1 000	1 050	1 105	1 150	1 211	1 150	1,07	1,02	2,79	2,65	/			
3 x 0,20+6 x 0,35	/	10/18	SS	/	/	1 805	1 947	/	/	/	/	/	1,19	1,13	5,53	5,25	/			
3 x 0,20+6 x 0,35	/	10/18	SZ	1 510	1 620	1 850	1 947	/	/	/	/	/	1,19	1,13	5,62	5,34	/			
3 x 0,22/9 x 0,20	CC	12,5	S	1 025	1 095	1 200	1 270	1 320	/	1 445	1 521	1 445	0,89	0,85	3,34	3,17	/			

Table 5 (continued)

Cord construction	Type	Lay length mm	Lay direction	Breaking load, N												Diameter mm			Linear density g/m		Elongation at break %																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
				NT			HT			ST			UT			Max.	Aim	Max.	Aim																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
				Min.	Aim	Min.	Aim	Min.	Aim	Min.	Aim	Min.	Aim																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
3 × 0,22/9 × 0,20+0,15	CC	12,5/5	SZ	1 025	1 095	1 200	1 270	1 320	/	1 445	1 521	1 700	1 789	1 830	1 888	495	560	621	670	705	705	1 445	1 521	1 700	1 789	1 830	1 888	2 385	2 660	2 910	3 175	3 430	3 685	3 940	4 195	4 450	4 705	4 960	5 215	5 470	5 725	5 980	6 235	6 490	6 745	7 000	7 255	7 510	7 765	8 020	8 275	8 530	8 785	9 040	9 295	9 550	9 805	10 060	10 315	10 570	10 825	11 080	11 335	11 590	11 845	12 100	12 355	12 610	12 865	13 120	13 375	13 630	13 885	14 140	14 395	14 650	14 905	15 160	15 415	15 670	15 925	16 180	16 435	16 690	16 945	17 200	17 455	17 710	17 965	18 220	18 475	18 730	18 985	19 240	19 495	19 750	20 005	20 260	20 515	20 770	21 025	21 280	21 535	21 790	22 045	22 300	22 555	22 810	23 065	23 320	23 575	23 830	24 085	24 340	24 595	24 850	25 105	25 360	25 615	25 870	26 125	26 380	26 635	26 890	27 145	27 400	27 655	27 910	28 165	28 420	28 675	28 930	29 185	29 440	29 695	29 950	30 205	30 460	30 715	30 970	31 225	31 480	31 735	31 990	32 245	32 500	32 755	33 010	33 265	33 520	33 775	34 030	34 285	34 540	34 795	35 050	35 305	35 560	35 815	36 070	36 325	36 580	36 835	37 090	37 345	37 600	37 855	38 110	38 365	38 620	38 875	39 130	39 385	39 640	39 895	40 150	40 405	40 660	40 915	41 170	41 425	41 680	41 935	42 190	42 445	42 700	42 955	43 210	43 465	43 720	43 975	44 230	44 485	44 740	44 995	45 250	45 505	45 760	46 015	46 270	46 525	46 780	47 035	47 290	47 545	47 800	48 055	48 310	48 565	48 820	49 075	49 330	49 585	49 840	50 095	50 350	50 605	50 860	51 115	51 370	51 625	51 880	52 135	52 390	52 645	52 900	53 155	53 410	53 665	53 920	54 175	54 430	54 685	54 940	55 195	55 450	55 705	55 960	56 215	56 470	56 725	56 980	57 235	57 490	57 745	58 000	58 255	58 510	58 765	59 020	59 275	59 530	59 785	60 040	60 295	60 550	60 805	61 060	61 315	61 570	61 825	62 080	62 335	62 590	62 845	63 100	63 355	63 610	63 865	64 120	64 375	64 630	64 885	65 140	65 395	65 650	65 905	66 160	66 415	66 670	66 925	67 180	67 435	67 690	67 945	68 200	68 455	68 710	68 965	69 220	69 475	69 730	69 985	70 240	70 495	70 750	71 005	71 260	71 515	71 770	72 025	72 280	72 535	72 790	73 045	73 300	73 555	73 810	74 065	74 320	74 575	74 830	75 085	75 340	75 595	75 850	76 105	76 360	76 615	76 870	77 125	77 380	77 635	77 890	78 145	78 400	78 655	78 910	79 165	79 420	79 675	79 930	80 185	80 440	80 695	80 950	81 205	81 460	81 715	81 970	82 225	82 480	82 735	82 990	83 245	83 500	83 755	84 010	84 265	84 520	84 775	85 030	85 285	85 540	85 795	86 050	86 305	86 560	86 815	87 070	87 325	87 580	87 835	88 090	88 345	88 600	88 855	89 110	89 365	89 620	89 875	90 130	90 385	90 640	90 895	91 150	91 405	91 660	91 915	92 170	92 425	92 680	92 935	93 190	93 445	93 700	93 955	94 210	94 465	94 720	94 975	95 230	95 485	95 740	95 995	96 250	96 505	96 760	97 015	97 270	97 525	97 780	98 035	98 290	98 545	98 800	99 055	99 310	99 565	99 820	100 075	100 330	100 585	100 840	101 095	101 350	101 605	101 860	102 115	102 370	102 625	102 880	103 135	103 390	103 645	103 900	104 155	104 410	104 665	104 920	105 175	105 430	105 685	105 940	106 195	106 450	106 705	106 960	107 215	107 470	107 725	107 980	108 235	108 490	108 745	109 000	109 255	109 510	109 765	110 020	110 275	110 530	110 785	111 040	111 295	111 550	111 805	112 060	112 315	112 570	112 825	113 080	113 335	113 590	113 845	114 100	114 355	114 610	114 865	115 120	115 375	115 630	115 885	116 140	116 395	116 650	116 905	117 160	117 415	117 670	117 925	118 180	118 435	118 690	118 945	119 200	119 455	119 710	119 965	120 220	120 475	120 730	120 985	121 240	121 495	121 750	122 005	122 260	122 515	122 770	123 025	123 280	123 535	123 790	124 045	124 300	124 555	124 810	125 065	125 320	125 575	125 830	126 085	126 340	126 595	126 850	127 105	127 360	127 615	127 870	128 125	128 380	128 635	128 890	129 145	129 400	129 655	129 910	130 165	130 420	130 675	130 930	131 185	131 440	131 695	131 950	132 205	132 460	132 715	132 970	133 225	133 480	133 735	133 990	134 245	134 500	134 755	135 010	135 265	135 520	135 775	136 030	136 285	136 540	136 795	137 050	137 305	137 560	137 815	138 070	138 325	138 580	138 835	139 090	139 345	139 600	139 855	140 110	140 365	140 620	140 875	141 130	141 385	141 640	141 895	142 150	142 405	142 660	142 915	143 170	143 425	143 680	143 935	144 190	144 445	144 700	144 955	145 210	145 465	145 720	145 975	146 230	146 485	146 740	146 995	147 250	147 505	147 760	148 015	148 270	148 525	148 780	149 035	149 290	149 545	149 800	150 055	150 310	150 565	150 820	151 075	151 330	151 585	151 840	152 095	152 350	152 605	152 860	153 115	153 370	153 625	153 880	154 135	154 390	154 645	154 900	155 155	155 410	155 665	155 920	156 175	156 430	156 685	156 940	157 195	157 450	157 705	157 960	158 215	158 470	158 725	158 980	159 235	159 490	159 745	159 999	160 254	160 509	160 764	161 019	161 274	161 529	161 784	162 039	162 294	162 549	162 804	163 059	163 314	163 569	163 824	164 079	164 334	164 589	164 844	165 099	165 354	165 609	165 864	166 119	166 374	166 629	166 884	167 139	167 394	167 649	167 904	168 159	168 414	168 669	168 924	169 179	169 434	169 689	169 944	170 199	170 454	170 709	170 964	171 219	171 474	171 729	171 984	172 239	172 494	172 749	173 004	173 259	173 514	173 769	174 024	174 279	174 534	174 789	175 044	175 299	175 554	175 809	176 064	176 319	176 574	176 829	177 084	177 339	177 594	177 849	178 104	178 359	178 614	178 869	179 124	179 379	179 634	179 889	180 144	180 399	180 654	180 909	181 164	181 419	181 674	181 929	182 184	182 439	182 694	182 949	183 204	183 459	183 714	183 969	184 224	184 479	184 734	184 989	185 244	185 499	185 754	186 009	186 264	186 519	186 774	187 029	187 284	187 539	187 794	188 049	188 304	188 559	188 814	189 069	189 324	189 579	189 834	190 089	190 344	190 599	190 854	191 109	191 364	191 619	191 874	192 129	192 384	192 639	192 894	193 149	193 404	193 659	193 914	194 169	194 424	194 679	194 934	195 189	195 444	195 699	195 954	196 209	196 464	196 719	196 974	197 229	197 484	197 739	197 994	198 249	198 504	198 759	199 014	199 269	199 524	199 779	200 034	200 289	200 544	200 799	201 054	201 309	201 564	201 819	202 074	202 329	202 584	202 839	203 094	203 349	203 604	203 859	204 114	204 369	204 624	204 879	205 134	205 389	205 644	205 899	206 154	206 409	206 664	206 919	207 174	207 429	207 684	207 939	208 194	208 449	208 704	208 959	209 214	209 469	209 724	209 979	210 234	210 489	210 744	210 999	211 254	211 509	211 764	212 019	212 274	212 529	212 784	213 039	213 294	213 549	213 804	214 059	214 314	214 569	214 824	215 079	215 334	215 589	215 844	216 099	216 354	216 609	216 864	217 119	217 374	217 629	217 884	218 139	218 394	218 649	218 904	219 159	219 414	219 669	219 924	220 179	220 434	220 689	220 944	221 199	221 454	221 709	221 964	222 219	222 474	222 729	222 984	223 239	223 494	223 749	224 004	224 259	224 514	224 769	225 024	225 279	225 534	225 789	226 044	226 299	226 554	226 809	227 064	227 319	227 574	227 829	228 084	228 339	228 594	228 849	229 104	229 359	229 614	229 869	230 124	230 379	230 634	230 889	231 144	231 399	231 654	231 909	232 164	232 419	232 674	232 929	233 184	233 439	233 694	233 949	234 204	234 459	234 714	234 969	235 224	235 479	235 734	235 989	236 244	236 499	236 754	237 009	237 264	237 519	237 774	238 029	238 284	238 539	238 794	239 049	239

Table 5 (continued)

Cord construction	Type	Lay length mm	Lay direction	Breaking load, N												Diameter mm			Linear density g/m		Elongation at break %
				NT			HT			ST			UT			Max.	Aim	Max.	Aim		
				Min.	Aim		Min.	Aim		Min.	Aim		Min.	Aim							
3+8 × 0,33	/	10/18	SS	/	2 650	2 789	2 980	3 137	/	/	/	1,42	1,35	7,93	7,53	/					
3+8 × 0,35	/	10/20	SS	/	2 860	3 011	/	/	/	/	1,51	1,44	8,88	8,44	/						
3+8+13 × 0,18+0,15	/	5/10/16/3,5	SSZS	/	1 680	1 750	2 057	2 143	/	/	1,41	1,34	5,37	5,10	/						
3+8+13 × 0,22+0,15	/	6/12/18/3,5	SSZS	/	2 550	2 656	/	/	/	/	1,64	1,56	7,89	7,50	/						
3+9 × 0,175+0,15	/	5/10/3,5	SSZ	755	840	900	/	/	/	/	1,05	1,00	2,62	2,49	/						
3+9 × 0,22	/	6,3/12,5	SS	1 130	1 360	1 432	1 490	1 568	/	/	0,97	0,92	3,84	3,65	/						
3+9 × 0,22+0,15	/	6,3/12,5/3,5	SSZ	1 130	1 360	1 432	/	/	/	/	1,21	1,15	4,05	3,85	/						
3+9 × 0,225+8 × (1+6) × 0,226+0,175	/	7/14/12/30/2,5	ZZ/SS/Z	7 300	/	/	/	/	/	/	2,90	2,76	24,42	23,20	/						
3+9 × 0,25	/	7/14,5	SS	/	1 710	1 800	1 934	2 036	/	/	1,07	1,02	4,96	4,71	/						
3+9 × 0,25+0,15	/	7/14,5/5	SSZ	/	1 710	1 800	1 915	2 016	/	/	1,38	1,31	5,15	4,89	/						
3+9 × 0,25+8 × 7 × 0,22+0,175	/	6,8/13,5/13,5/33,3/5	SS/ZZ/S	/	/	/	/	/	/	/	2,84	2,70	23,35	22,18	/						
3+9+15 × 0,175	/	5/10/16	SSZ	1 620	1 955	2 036	/	/	/	/	1,12	1,07	5,47	5,20	/						
3+9+15 × 0,175+0,15	/	5/10/16/3,5	SSZS	1 620	1 955	2 036	2 130	2 219	/	/	1,41	1,34	5,71	5,42	/						
3+9+15 × 0,20	/	6,3/12,5/15	ZZZ	/	/	/	2 800	2 917	/	/	1,28	1,22	7,08	6,80	/						
3+9+15 × 0,22	/	6,3/12,5/18	SSZ	2 600	2 900	3 100	/	/	/	/	1,42	1,35	8,71	8,27	/						
3+9+15 × 0,22	/	6,3/12,5/18	ZZZ	/	2 945	3 068	/	/	/	/	1,42	1,35	8,71	8,27	/						

Table 5 (continued)

Cord construction	Type	Lay length mm	Lay direction	Breaking load, N												Linear density g/m			Elongation at break %
				NT			HT			ST			UT			Max.	Aim	/	
				Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.	Min.	Aim	Max.				
3+9+15 × 0,22+0,15	/	6,3/ 12,5/ 18/3,5	SSZS	2 600	2 750	3 070	2 900	3 070	/	/	/	/	/	1,70	1,62	8,95	8,50	/	
3+9+15 × 0,22+0,15	/	6,3/ 12,5/ 18/3,5	ZZZS	/	/	3 068	2 945	3 068	/	/	/	/	/	1,70	1,62	8,95	8,50	/	
3+9+15 × 0,225	/	6,3/ 12,5/ 18	ZZZ	/	/	3 250	3 120	3 250	3 510	3 656	/	/	/	1,46	1,39	9,08	8,63	/	
3+9+15 × 0,225+0,15	/	6,3/ 12,5/ 18/5	ZZZS	/	/	3 250	3 120	3 250	/	/	/	/	/	1,71	1,63	9,24	8,78	/	
3+9+15 × 0,245	/	6,3/ 12,5/ 18	ZZZ	/	/	3 885	3 730	3 885	/	/	/	/	/	1,59	1,51	10,80	10,26	/	
3+9+15 × 0,245+0,15	/	6,3/ 12,5/ 18/5	ZZZS	/	/	3 885	3 730	3 885	/	/	/	/	/	1,86	1,77	11,03	10,48	/	
4 × 0,21	/	10	S	/	/	/	/	/	/	/	/	480	510	0,54	0,51	1,16	1,10	/	
4 × 2 × 0,25	HE	3,5/6	SS	870	/	/	/	/	/	/	/	/	/	1,19	1,12	3,37	3,20	3,5	
4 × 2 × 0,34	HE	3,0/7,5	SS	1 330	/	/	/	/	/	/	/	/	/	1,59	1,50	6,63	6,30	5,0	
4 × 2 × 0,35	HE	3,9/10	SS	1 390	1 490	/	/	/	/	/	/	/	/	1,69	1,59	6,94	6,59	3,5	
4 × 2 × 0,35	HE	3,5/7,5	SS	1 400	/	/	/	/	/	/	/	/	/	1,64	1,55	7,03	6,68	3,5	
4 × 4 × 0,20	HE	4,0/7,0	SS	1 090	/	1 337	1 270	1 337	/	/	/	/	/	1,31	1,24	4,62	4,39	4,0	
4 × 4 × 0,22	HE	3,5/5	SS	1 150	1 220	/	/	/	/	/	/	/	/	1,40	1,32	5,68	5,40	4,0	
4 × 4 × 0,225	HE	4,3/7,5	SS	1 360	/	1 563	1 485	1 563	/	/	/	/	/	1,44	1,36	5,69	5,41	4,0	
4 × 6 × 0,25	HE	5,7/9,5	SS	2 480	/	/	/	/	/	/	/	/	/	1,93	1,82	10,71	10,17	4,0	
4+3 × 0,33	/	∞/18/18	-SS	/	/	/	/	/	1 880	1 979	/	/	/	1,19	1,10	4,98	4,74	/	
4+3 × 0,35	/	∞/18	-S	/	/	1 921	1 825	1 921	2 075	2 184	2 260	2 379	/	1,29	1,19	5,59	5,31	/	
4+6 × 0,30	/	∞/18	-S	/	/	2 084	1 980	2 084	2 240	2 358	/	/	/	1,27	1,18	5,92	5,62	/	