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Steel wire and wire products — Hose reinforcement wire

Fils et produits tréfilés en acier — Fil d'armature pour flexibles

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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).

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).

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

For an explanation of 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 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 23717:2006), which has been technically revised.

The main changes are as follows:

— Annex A on packaging added;

— Clause 2 updated;

— Clause 3 updated;

— classification from LT to UT updated (see Clause 4);

— Cu content of coating updated (see 6.1.4);

— breaking load for mechanical properties added (see 6.2.1 and Table 1);

— product list and mechanical properties updated (see Table 1);

— cast and tip rise/dead cast requirement added (see 6.3.3 and Table 3);

— tolerance on diameter updated (see Table 4);

— welds requirement updated (see 6.5.2);

— test procedures for Cast and tip rise/dead cast and coating test added (see 7.3.4 and 7.3.5);

— labelling information for packing updated (see Table 5).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Steel wire and wire products — Hose reinforcement wire

1 Scope

This document specifies the composition, dimensions and mechanical properties of steel wire with a high mass fraction of carbon, generally brass coated, for reinforcing high-pressure hoses.

It is applicable to multiple parallel wires, braided or spirally wrapped for reinforcement in a rubber or synthetic hose that is made to withstand a relatively high bursting pressure.

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 404, *Steel and steel products — General technical delivery requirements*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 7800, *Metallic materials — Wire — Simple torsion test*

ISO 7801, *Metallic materials — Wire — Reverse bend test*

ISO 10474, *Steel and steel products — Inspection documents*

ISO 16120-1, *Non-alloy steel wire rod for conversion to wire — Part 1: General requirements*

ISO 16120-2, *Non-alloy steel wire rod for conversion to wire — Part 2: Specific requirements for general purpose wire rod*

ISO 16120-4, *Non-alloy steel wire rod for conversion to wire — Part 4: Specific requirements for wire rod for special applications*

ISO 23475-1, *Testing method for steel tyre cord — Part 1: General requirements*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
nominal diameter
d
value of the diameter by which the wire is designated and specified by the purchaser

Note 1 to entry: The nominal diameter is expressed in millimetres.

Note 2 to entry: This is the basis on which the values of all relevant characteristics are determined for the acceptance of the wire.

3.2
out of roundness
arithmetic difference between the maximum and minimum diameter measured in a transverse cross-section perpendicular to the wire axis

3.3
cast
smallest external diameter of a wire loops naturally formed when placed on a smooth surface without external tension

3.4
tip rise/dead cast
vertical height of the cut wire end that protrudes above the flat and smooth surface, on which the wire is placed without external tension

4 Classification

Hose wire is classified according to five classes of tensile strength.

— LT: Low tensile strength, 2 150 MPa to 2 450 MPa;

— NT: Normal tensile strength, 2 450 MPa to 2 750 MPa;

— HT: High tensile strength, 2 750 MPa to 3 050 MPa;

— ST: Super tensile strength, 3 050 MPa to 3 350 MPa;

— UT: Ultra tensile strength, 3 350 MPa to 3 650 MPa.

5 Designation and ordering

5.1 Designation

For hose wire supplies, the designation shall state, in the following order:

— the term: hose wire;

— the coating: see 6.1.4;

— a reference to this document, i.e. ISO 23717:2022;

— the tensile strength class (see Clause 4) and the nominal tensile strength;

— the nominal diameter.

Example Brass coated hose wire, 0,30 mm, high tensile strength HT in accordance with ISO 23717 shall be designated.

Hose wire brass coated ISO 23717-HT-0,30.

5.2 Information supplied by the purchaser and items to be agreed upon

The purchaser shall clearly state the following information concerning the product in the enquiry or order:

— the required nominal diameter;

— the desired quantity;

— the coating material;

— the type of inspection document.

EXAMPLE 20 t hose wire brass coated ISO 23717-HT-0,30 on spools of 30 kg doc ISO 10474-“3.1”.

6 Requirements

6.1 Material

6.1.1 Steel

The wire shall be manufactured from steel rod in accordance with ISO 16120-1 and ISO 16120-2 for tensile strengths LT and NT, and in accordance with ISO 16120-4 for tensile strengths HT, ST and UT.

6.1.2 Chemical composition

The chemical composition according to the heat analysis and the permissible deviation of the product analysis from the heat analysis shall be in accordance with ISO 16120-2 and ISO 16120-4.

In cases of dispute, the analysis shall be carried out by a laboratory approved by the two parties. The method of analysis to be applied shall be agreed upon, see for example ISO/TR 9769.

6.1.3 Wire

The wire shall be patented or hard rolled and cold drawn in order to provide the required mechanical properties.

6.1.4 Coating material

If not otherwise stipulated by the purchaser at the time of enquiry or order (see 5.2), the coating material shall be brass with a chemical composition of Cu: (67,5 ± 4) %. A tighter range may be agreed upon.

In the case of other coatings, the specification shall be agreed between the purchaser and supplier at the time of enquiry or order.

6.2 Mechanical properties

6.2.1 Tensile strength, breaking load and elongation

Purchaser and supplier can agree to specify the tensile strength class and diameter, or breaking load range and diameter.

When tested in accordance with 7.3.1 before and after the braiding operation, the wire shall conform to the tensile strength or breaking load values and have an elongation at rupture as specified in Table 1.

6.2.2 Reverse bend test

When tested in accordance with 7.3.2, the wire shall withstand the minimum number of reverse bends (N_b), as specified in Table 1 without rupture.

6.2.3 Torsion test

When tested in accordance with 7.3.2, the wire shall withstand the minimum number of torsions (N_t), as specified in Table 1 without fracture.

Table 1 — Mechanical properties

Diameter, d mm	**Tensile strength class**[a] MPa	**Breaking load range**[b] N	**Elongation at rupture** A_t, %, **min.**	**Reverse bends** (N_b) **on r2,5 mm min.**	**Torsion** (N_t) (l=200d) **min.**
	Low tensile strength (LT)				
0,28	2 150 to 2 450	129 to 154	1,6	125	80
0,295	2 150 to 2 450	143 to 171	1,6	105	78
0,30	2 150 to 2 450	148 to 177	1,6	105	78
0,35	2 150 to 2 450	203 to 239	1,6	85	72
0,38	2 150 to 2 450	241 to 281	1,6	75	70
0,40	2 150 to 2 450	267 to 311	1,6	65	68
0,45	2 150 to 2 450	339 to 392	1,8	55	63
0,50	2 150 to 2 450	420 to 483	1,9	46	60
0,56	2 150 to 2 450	529 to 604	2,0	45	55
0,60	2 150 to 2 450	608 to 693	2,0	40	52
0,65	2 150 to 2 450	715 to 812	2,2	35	48
0,71	2 150 to 2 450	854 to 967	2,2	30	45
0,75	2 150 to 2 450	954 to 1 078	2,2	24	40
0,78	2 150 to 2 450	1 033 to 1 165	2,2	23	37
0,80	2 150 to 2 450	1 087 to 1 225	2,2	22	35
1,00	2 150 to 2 450	1 705 to 1 908	2,5	10	15
	Normal tensile strength (NT)				
0,20	2 450 to 2 750	73 to 90	1,6	170	85
0,22	2 450 to 2 750	89 to 109	1,6	150	82
0,25	2 450 to 2 750	116 to 139	1,6	125	78
0,28	2 450 to 2 750	146 to 174	1,6	110	76
0,295	2 450 to 2 750	163 to 192	1,6	95	74
0,30	2 450 to 2 750	169 to 199	1,6	95	74
0,33	2 450 to 2 750	205 to 240	1,6	85	69
0,35	2 450 to 2 750	231 to 269	1,6	80	67
0,38	2 450 to 2 750	273 to 316	1,6	65	66
0,40	2 450 to 2 750	303 to 350	1,6	60	65
0,45	2 450 to 2 750	386 to 441	1,8	50	58
0,50	2 450 to 2 750	478 to 544	1,9	35	55
0,56	2 450 to 2 750	601 to 680	2,0	30	49
0,60	2 450 to 2 750	691 to 779	2,0	28	47
Normal tensile strength (NT)					
0,65	2 450 to 2 750	812 to 913	2,2	27	43
0,71	2 450 to 2 750	971 to 1 088	2,2	25	40
0,75	2 450 to 2 750	1 085 to 1 213	2,2	23	36
0,78	2 450 to 2 750	1 174 to 1 311	2,2	21	33

NOTE Special requirement can be determined by agreement between the purchaser and the supplier.

[a] Tensile strength and breaking load should be measured fresh and may increase above the upper limit after natural ageing.

[b] The breaking load range is calculated based on 6 sigma method.

Table 1 *(continued)*

Diameter, d mm	**Tensile strength class**[a] MPa	**Breaking load range**[b] N	**Elongation at rupture** A_t, %, **min.**	**Reverse bends** (N_b) **on r2,5 mm min.**	**Torsion** (N_t) (l=200d) **min.**
0,80	2 450 to 2 750	1 235 to 1 378	2,2	20	30
	High tensile strength (HT)				
0,20	2 750 to 3 050	82 to 100	1,3	160	80
0,22	2 750 to 3 050	100 to 121	1,6	145	80
0,25	2 750 to 3 050	130 to 155	1,6	120	76
0,28	2 750 to 3 050	164 to 193	1,6	100	74
0,295	2 750 to 3 050	183 to 214	1,6	85	72
0,30	2 750 to 3 050	189 to 221	1,6	85	72
0,33	2 750 to 3 050	230 to 266	1,6	74	66
0,35	2 750 to 3 050	259 to 299	1,6	66	64
0,38	2 750 to 3 050	306 to 352	1,6	60	61
0,40	2 750 to 3 050	340 to 389	1,6	50	57
0,45	2 750 to 3 050	432 to 491	1,8	40	50
0,50	2 750 to 3 050	535 to 604	1,9	25	45
0,56	2 750 to 3 050	673 to 756	2,0	25	41
0,60	2 750 to 3 050	774 to 866	2,0	20	39
0,65	2 750 to 3 050	910 to 1 015	2,2	20	35
0,71	2 750 to 3 050	1 087 to 1 209	2,2	15	32
0,80	2 750 to 3 050	1 384 to 1 532	2,2	15	25
	Super tensile strength (ST)				
0,20	3 050 to 3 350	91 to 110	1,3	110	70
0,25	3 050 to 3 350	144 to 170	1,6	80	65
0,28	3 050 to 3 350	182 to 212	1,6	75	62
0,295	3 050 to 3 350	202 to 235	1,6	60	60
0,30	3 050 to 3 350	209 to 243	1,6	60	60
0,33	3 050 to 3 350	254 to 293	1,6	50	58
0,38	3 050 to 3 350	339 to 387	1,6	40	50
0,40	3 050 to 3 350	376 to 428	1,6	35	45
0,50	3 050 to 3 350	592 to 664	2,0	25	35
0,56	3 050 to 3 350	754 to 831	2,0	20	30
Super tensile strength (ST)					
0,60	3 050 to 3 350	857 to 953	2,0	15	21
0,71	3 050 to 3 350	1 204 to 1 330	2,0	12	15
	Ultra tensile strength (UT)				
0,25	3 350 to 3 650	158 to 186	1,6	55	54
0,295	3 350 to 3 650	221 to 257	1,6	40	52
0,30	3 350 to 3 650	229 to 265	1,6	40	52

NOTE Special requirement can be determined by agreement between the purchaser and the supplier.

[a] Tensile strength and breaking load should be measured fresh and may increase above the upper limit after natural ageing.

[b] The breaking load range is calculated based on 6 sigma method.

6.3 Surface quality

6.3.1 General

The wire shall not have defects such as waviness, knots, undulation, etc. The surface of the wire shall be smooth and free from grease/foreign matter, stains, oxidation areas and other contaminants, mechanical damage, scratches or brass coating damage and delamination, etc.

The wire should be uniformly and continuously coated with brass, with the exception of half-product welds.

6.3.2 Coating mass

The mass of coating on the wire shall be in accordance with the values listed in Table 2.

Table 2 — Coating mass

Diameter, *d* mm	**Coating mass** g/kg
$d^a \leq 0{,}33$	5 ± 2
$0{,}33 < d$	4 ± 2
[a] For those diameters, a coating mass of 5 ± 3 g/kg can be applied following an agreement between the parties concerned.	

6.3.3 Cast and tip rise/dead cast

If not otherwise stipulated by the purchaser at the time of enquiry or order, the cast and tip rise/dead cast shall be in accordance with the values listed in Table 3.

Table 3 — Cast and tip rise

Diameter, *d* mm	**Cast** mm	**tip rise/dead cast** mm
$0{,}20 \leq d < 0{,}65$	100 to 250	<40
$0{,}65 \leq d \leq 1{,}0$	150 to 300	<40

6.4 Dimensions and tolerances

6.4.1 Tolerance on diameter

The tolerance on the nominal wire diameter shall be in accordance with the values listed in Table 4:

Table 4 — Tolerance on diameter

Diameter, *d* mm	**Tolerance on diameter** mm
$0{,}20 \leq d < 0{,}65$	±0,010
$0{,}65 \leq d \leq 1{,}0$	±0,015

6.4.2 Out of roundness

The out of roundness shall be not more than half the tolerance on diameter.

6.5 Delivery conditions

6.5.1 Unit package

The wire shall be supplied in units of one single length of wire, the unit package being spools.

6.5.2 Welds

Welding on intermediate half-product is permitted, provided the weld is properly cleaned and smooth so as to permit proper processing. Welding on final construction sizes is not permitted.

The weld and heat-affected zone shall have a minimum breaking force of 40 % of the minimum specified in Table 1.

One weld per spool and three welds per carton maximum are permitted.

NOTE Welding numbers on intermediate half-product can also be determined by agreement between the purchaser and the supplier.

7 Testing and inspection

7.1 Testing and inspection documents

Products shall be delivered with specific testing (see ISO 404) and the relevant inspection document, in accordance with ISO 10474, specified by the purchaser at the time of enquiry or order (see 5.2).

7.2 Scope of test programme for acceptance inspection

Where appropriate, statistical testing shall be performed in accordance with criteria to be agreed between the purchaser and the supplier.

7.3 Test procedures

7.3.1 Tensile test

Tensile testing shall be carried out in accordance with ISO 6892-1 on pieces comprising the full cross-section of the wire. The minimum breaking force and the elongation (A_t) at the moment of rupture shall be recorded.

7.3.2 Reverse bend test and torsion test

The torsion test and reverse bend test shall be performed in accordance with ISO 7800 and ISO 7801.

The test length (l) for the torsion test shall be 200d. If agreed between the purchaser and the supplier, the test length and the spec could be changed.

The test pieces shall be subjected to a thermal ageing treatment at 150 °C for 1 h. If agreed between the purchaser and the supplier, the thermal ageing treatment may be omitted and the spec could be changed.

7.3.3 Diameter and out of roundness

The diameter shall be measured using a micrometer with a precision of ±0,001 mm.

7.3.4 Cast and tip rise/dead cast

The cast and tip rise/dead cast shall be measured using a ruler with a precision of ±1 mm without external tension.

7.3.5 Coating test

The test on brass coating components and mass fraction of copper shall be in accordance with ISO 23475-1.

7.4 Retests

Retests shall be performed in accordance with ISO 404.

8 Marking, labelling and packaging

Each spool and each unit package shall be marked with the information needed to permit traceability and reference to inspection documents.

Each spool and each unit package shall have a label attached to it, bearing at least the information specified in Table 5.

Other information on the label shall be as agreed between the purchaser and the supplier.

Wire shipments shall be suitably protected against mechanical damage and/or contamination during transport. See Annex A for examples of packaging details.

Table 5 — Packing information

Information	Spool	Box
Product identification (*d*, TS class, length)	+	+
Manufacturing plant	+	+
Identification number	+	(+)
Batch number		(+)
Delivery or order number		+
Mass (nett and gross) in kg		+
Origin		+
Customer reference		(+)
+ = mandatory (+) = optional or customer required		

Annex A
(informative)

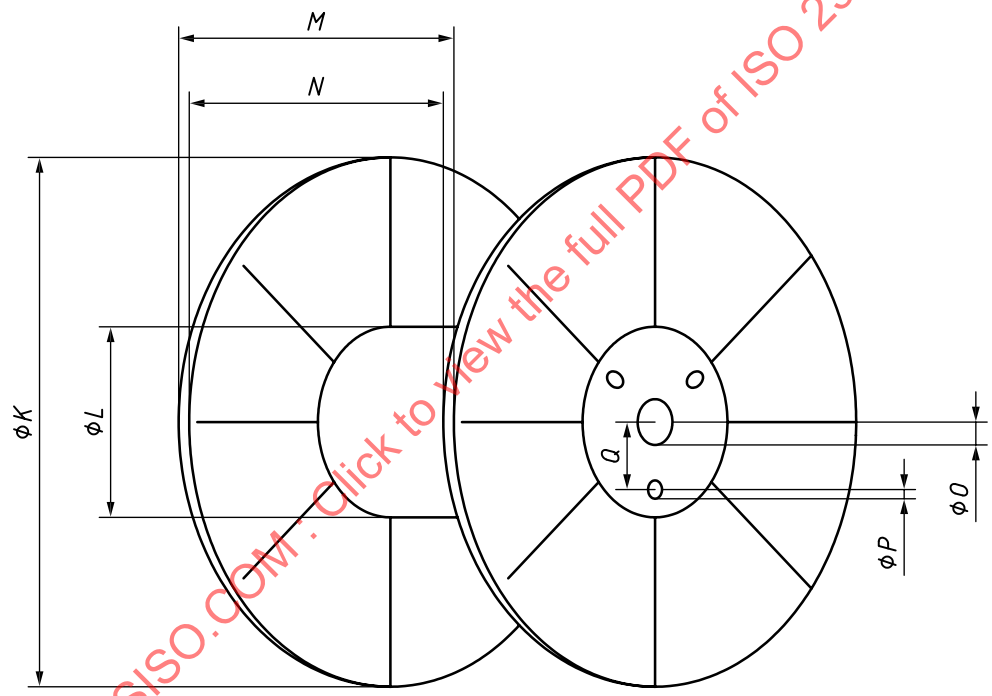
Packaging of hose reinforcement wire

A.1 Recommended types of spool

Hose reinforcement wire is supplied wound on metal or plastic spools. See Figure A.1.

NOTE The arrow on the flange indicates the rotation direction for unwinding the spool.

Recommended types of spool are given in Table A.1.



Key

K diameter of flange
L diameter of barrel
M overall width
N traverse
O bore
P number x diameter of drivehole/bore
Q distance of drivehole /bore

Figure A.1 — Spool for packing hose reinforcement wire

Table A.1 — Recommended types of spool

Dimensions in millimetres

Spool type	BP60
Diameter of flange (*K*)	254
Diameter of barrel (*L*)	102
Overall width (*M*)	184
Traverse (N)	153
Bore (O)	32,5 to 33
Number x diameter of drivehole	3x6
Distance drivehole/bore (*Q*)	30
Mass (kg)	1,2 to 1,4
Approximate wire capacity (kg)	28

NOTE Special requirement on spool type can be agreed between purchaser and supplier.

A.2 Example of wire length per spool

Table A.2 gives examples of wire length per spool. Tolerance of the wire length is suggested ±0,3 % for diameter equal to or smaller than 0,8 mm, and ±0,5 % for diameter bigger than 0,8 mm.

Table A.2 — Example of wire length per spool

Diameter mm	**Length per BP60 spool** m	**Diameter** mm	**Length per BP60 spool** m
0,20	100 000	0,40	30 000
0,22	91 500	0,45	24 000
0,25	82 500	0,50	21 000
0,28	60 000	0,56	15 000
0,295	60 000	0,60	14 000
0,30	58 000	0,65	11 000
0,33	45 000	0,70	9 500
0,35	40 000	0,80	7 000
0,38	35 000	1,00	4 200

NOTE Special requirement on wire length can be agreed between purchaser and supplier.

A.3 Recommended types of packaging

The hose reinforcement wire spools are packed in a waterproof carton strapped to a pallet in units of approximately 1 500 kg net mass. The pallet is made of wood or plastic. Some internationally recognized packaging styles are listed in Table A.3 and Figure A.2.

Table A.3 — Example of packaging

Type of spools	Composition	Number of spools
BS60, BP60	4×3×4	48
BS60, BP60	4×3×5	60