INTERNATIONAL STANDARD

ISO 6934-2

First edition
1991-07-01

Steel for the prestressing of concrete —

Part 2:
Cold-drawn wire

Acier pour armatures de précontrainte —
Partie 2: Fil tréfilé à froid

Reference number
ISO 6934-2:1991(E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 6934-2 was prepared by Technical Committee ISO/TC 17, *Steel*.

ISO 6934 consists of the following parts, under the general title *Steel for the prestressing of concrete*:

— *Part 1: General requirements*

— *Part 2: Cold-drawn wire*

— *Part 3: Quenched and tempered wire*

— *Part 4: Strand*

— *Part 5: Hot-rolled steel bars with or without subsequent processing*

Annexes A and B of this part of ISO 6934 are for information only.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Steel for the prestressing of concrete —

Part 2:
Cold-drawn wire

1 Scope

This part of ISO 6934 specifies requirements for round, cold-drawn, high-tensile steel wire, either plain, indented, ribbed or crimped. The product is supplied as mill coil wire or straightened and stress-relieved wire in coils or cut lengths, according to the general requirements specified in ISO 6934-1.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 6934. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 6934 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6934-1:1991, *Steel for the prestressing of concrete — Part 1: General requirements.*

3 Definitions

For the purposes of ISO 6934, the definitions given in ISO 6934-1 apply.

4 Conditions of manufacture

The wire shall be manufactured from high carbon steel in accordance with ISO 6934-1.

The wire shall be supplied without welds or other joints.

5 Surface configuration

There are several types of surface configuration (ribs, indentations, crimps), the purpose of which is to improve bond properties between wire and concrete. The type of surface configuration shall be agreed between purchaser and manufacturer.

Examples of indentations and crimps are given in annex A.

6 Properties

The designations, data for information and required properties are given in table 1 and table 2.

6.1 Dimensions and properties of mill coil wire

6.1.1 Dimensions, masses and tensile properties

See table 1.

6.1.2 Elongation and ductility

The percentage total elongation at maximum force, measured on a length of 200 mm, shall be not less than 1,5 %.

All wires shall show a ductile fracture with a constriction visible to the naked eye.

All wires shall withstand a reverse bend test around the bend radius given in the last column of table 1. The minimum number of bends is four for plain wires and three for indented and ribbed wires.

Table 1 — Dimensions, masses and tensile properties of mill coil wire

Nominal diameter	Nominal tensile strength[1]	Nominal cross-sectional area	Mass per length		Characteristic[2]		Bend radius
			Nominal[3]	Permissible deviation	maximum force[4]	0,1 % proof force	
mm	N/mm²	mm²	g/m	g/m	kN	kN	mm
8	1 470	50,3	395	±5,9	73,9	59,1	20
8	1 570	50,3	395	±5,9	79,0	63,2	20
7	1 570	38,5	302	±4,3	60,4	48,3	20
7	1 670	38,5	302	±4,3	64,3	51,4	20
6	1 670	28,3	222	±3,7	47,3	37,8	15
6	1 770	28,3	222	±3,7	50,1	40,1	15
5	1 670	19,6	154	±3,1	32,7	26,2	15
5	1 770	19,6	154	±3,1	34,7	27,8	15
4	1 670	12,6	98,9	±2,0	21,0	16,8	10
4	1 770	12,6	98,9	±2,0	22,3	17,8	10
3	1 770	7,07	55,5	±1,5	12,5	10,0	7,5
3	1 860	7,07	55,5	±1,5	13,1	10,5	7,5
2,5	1 860	4,91	38,5	±1,25	9,13	7,3	7,5
2,5	1 960	4,91	38,5	±1,25	9,62	7,7	7,5

1) The nominal tensile strength is for designation purposes only and is calculated from the nominal cross-sectional area and the characteristic maximum force and rounded off to the nearest 10 N/mm².

2) In view of the small tolerance on mass per length, characteristic forces have been specified rather than stresses.

3) The mass per length is calculated by adopting conventionally the value 7,85 kg/dm³ as the density of steel.

4) In order to prove the suitability of the material, which is only used in certain applications (e.g. for railway sleepers, piles or tanks) there is a requirement for a force at 1 % total elongation to be at least 80 % of the characteristic maximum force.

6.1.3 Relaxation

The relaxation at 1 000 h at an initial force of 70 % of the characteristic maximum force specified in table 1 shall be not more than 10 %.

If required, the same test shall be performed at an initial force of 60 % of the characteristic maximum force (see table 1). The maximum relaxation is then 8 %.

6.1.4 Fatigue

If agreed between purchaser and manufacturer, the material shall withstand, without failure, 2×10^6 cycles of a stress fluctuating down from a maximum stress of 70 % of the nominal tensile strength. The stress range shall be 200 N/mm² for plain wire and 180 N/mm² for intended and ribbed wire.

6.2 Dimensions and properties of stress-relieved wire

6.2.1 Dimensions, masses and tensile properties

See table 2.

6.2.2 Elongation and ductility

The percentage total elongation at maximum force, measured on a length of 200 mm, shall be not less than 3,5 %. All wires shall show a ductile fracture with a constriction visible to the naked eye.

All wires shall withstand a reverse bend test around the bend radius given in the last column of table 2. The minimum number of bends is four for plain wires and three for indented and ribbed wires.

6.2.3 Relaxation

The relaxation at 1 000 h at an initial force of 70 % of the characteristic maximum force specified in table 2 shall be determined.

If requested, the relaxation at 1 000 h shall be determined also at initial forces of 60 % and 80 % of the characteristic maximum force (see table 2). The maximum relaxation values are listed in table 3.

Table 2 — Dimensions, masses and tensile properties of stress-relieved wire

Nominal diameter	Nominal tensile strength[1]	Nominal cross-sectional area	Mass per length		Characteristic[2] maximum force	Characteristic[2] proof force		Bend radius
			Nominal[3]	Permissible deviation		0,1 %[4) 5) 6)]	0,2 %[4) 6)]	
mm	N/mm²	mm²	g/m	g/m	kN	kN	kN	mm
12,2	1 470	117	918	± 10,5	172	138	141	30
12,2	1 570	117	918	± 10,5	184	147	151	30
10	1 470	78,5	617	± 8,6	115	92,3	94,3	25
10	1 570	78,5	617	± 8,6	123	98,6	101	25
9	1 470	63,6	499	± 7,2	93,5	74,8	76,7	25
8	1 570	50,3	395	± 5,9	79,0	65,6	67,1	20
8	1 670	50,3	395	± 5,9	84,0	69,7	71,4	20
7	1 570	38,5	302	± 4,3	60,4	50,1	51,3	20
7	1 670	38,5	302	± 4,3	64,3	53,4	54,7	20
6	1 670	28,3	222	± 3,7	47,3	39,3	40,2	15
6	1 770	28,3	222	± 3,7	50,1	41,6	42,6	15
5	1 670	19,6	154	± 3,1	32,7	27,2	27,8	15
5	1 770	19,6	154	± 3,1	34,7	28,8	29,5	15
4	1 670	12,6	98,9	± 2,0	21,0	17,5	17,9	10
4	1 770	12,6	98,9	± 2,0	22,3	18,5	19,0	10

1) The nominal tensile strength is for designation purposes only and is calculated from the nominal cross-sectional area and the characteristic maximum force and rounded off to the nearest 10 N/mm².

2) In view of the small tolerance on mass per length, characteristic forces have been specified rather than stresses.

3) The mass per length is calculated by adopting conventionally the value 7,85 kg/dm³ as the density of steel.

4) For wires of diameter larger than 8 mm, the characteristic 0,1 % and 0,2 % proof forces are approximately 80 %, respectively 82 %, of the characteristic maximum force. For wires 8 mm and smaller, the corresponding figures are approximately 83 %, respectively 85 %.

5) The modulus of elasticity may be taken to be 205 kN/mm² ± 10 kN/mm².

6) 0,1 % proof force is mandatory and 0,2 % proof force is for information only (see ISO 6934-1), except when otherwise agreed.

Table 3 — Maximum relaxation values

Initial force in percentage of the characteristic maximum force	Relaxation class	
	Relax 1 %	Relax 2 %
70	8,0	2,5
60	4,5	1,0
80	12,0	4,5

6.2.4 Fatigue

If agreed between purchaser and manufacturer, the material shall withstand, without failure, 2×10^6 cycles of a stress fluctuating down from a maximum stress of 70 % of the nominal tensile strength. The stress range shall be 200 N/mm² for plain wire and 180 N/mm² for indented and ribbed wire.

In the absence of data use 100 N/mm² provisionally as the stress range for crimped wire.

7 Designation

The wire shall be ordered in accordance with ISO 6934-1 and be designated as follows.

a) ISO 6934-2;

b) letter referring to treatment:

M = mill coil wire (see ISO 6934-1)
S = stress-relieved wire (see ISO 6934-1);

c) letter referring to wire surface (see ISO 6934-1):

P = plain
I = indented
C = crimped
R = ribbed;

d) nominal diameter, in millimetres;

e) nominal tensile strength, in newtons per square millimetre;

f) relaxation class (Relax 1 or Relax 2).

Example:

Stress-relieved indented wire of nominal diameter 7 mm and nominal strength 1 570 N/mm^2 with class 1 relaxation is designated:

ISO 6934-2-SI-7-1 570-Relax 1.

8 Delivery conditions

Delivery conditions shall be in accordance with ISO 6934-1 and the following requirements.

8.1 Coil size

The internal diameter of mill coils shall be agreed between purchaser and manufacturer.

Stress-relieved wire shall be wound into large diameter coils, in order to avoid a change in mechanical properties and to ensure satisfactory straightness (see 8.2).

An example of suitable diameters is given in annex B. The minimum coil diameter shall be not less than 200 times the wire diameter.

8.2 Curvature of stress-relieved wires

When a length of wire is lying free on a plain surface, the maximum bow height from a base-line 1 m in length, measured from the inside of the curve, shall be not greater than 30 mm for any wire diameter.

Annex A
(informative)

Examples of indentations and crimps

A.1 Indentations

The following example indicates a widely used arrangement of indentations. The nominal dimensions of the indentations related to nominal wire diameters are as shown in figure A.1 and table A.1. Other forms of indentations may be used.

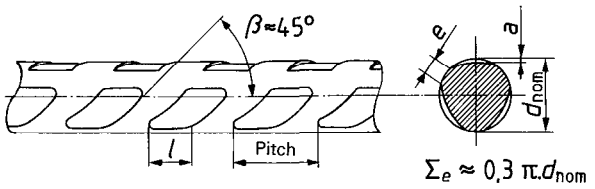

Figure A.1 — Indentations

A.2 Crimps

The following example indicates two methods of crimping, helical and uniplanar. The total wave height (excluding the wire diameter) and pitch of crimping are shown in figure A.2 and table A.2. Other forms of crimping may be used.

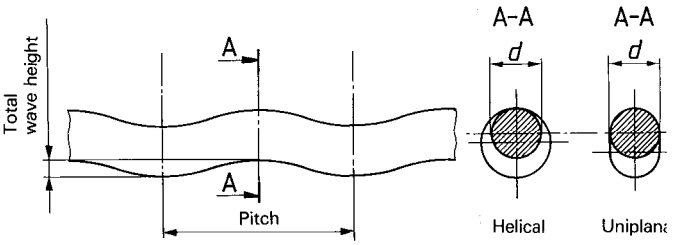

Figure A.2 — Crimps

Table A.1 — Nominal indentation dimensions

Dimensions in millimetres

Nominal wire diameter d_{nom}	Nominal indentation dimension		
	Depth a	Length l min	Pitch min.
⩽ 5,0	0,12 ± 0,05	3,5	5,5
> 5,0	0,15 ± 0,05	5,0	8,0

Table A.2 — Crimp dimensions

Type of crimp	Pitch	Total wave height (excluding the wire diameter, d)	
		Helical	Uniplanar
Short pitch	5d to 10d	5 % d to 10 % d	10 % d to 20 % d
Long pitch	8d to 12d	6 % d to 12 % d	12 % d to 25 % d

Annex B
(informative)

Recommended internal diameter of coil

A list of recommended internal diameters of coil is given in table B.1.

Table B.1 — Recommended internal diameters of coil

Nominal wire diameter mm	Recommended internal diameter m
4 5 6, 7 and 8 10 and 12,2	1,25 or 2 1,5 or 2 2 2,5

UDC 669.14-124.2-426:691.714:691.328

Descriptors: concrete, prestressed concrete, steels, prestressing steels, cold drawn products, wire, specifications, dimensions, designation, delivery condition.

Price based on 6 pages