INTERNATIONAL STANDARD

ISO 6934-3

First edition
1991-12-15

Steel for the prestressing of concrete —

Part 3:
Quenched and tempered wire

Acier pour armatures de précontrainte —

Partie 3: Fil trempé et revenu

Reference number
ISO 6934-3:1991(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 6934-3 was prepared by Technical Committee ISO/TC 17, *Steel*, Sub-Committee SC 16, *Steels for the reinforcement and prestressing of concrete*.

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*

Annex A of this part of ISO 6934 is 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 3:
Quenched and tempered wire

1 Scope

This part of ISO 6934 specifies requirements for round wire made of quenched and tempered high tensile steel, with a surface which is either plain, ribbed, grooved or indented. The product is delivered in coils, according to the general requirements specified in ISO 6934-1.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 6934. At the time of publication, the editions indicated were 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 editions of the standards 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.*

ISO 7801:1984, *Metallic materials — Wire — Reverse bend test.*

ISO 10065:1990, *Steel bars for reinforcement of concrete — Bend and rebend tests.*

3 Definitions

For the purposes of this part of ISO 6934, the definitions given in ISO 6934-1 and the following definition apply.

3.1 grooved wire: Wire whose surface has continuous helical grooves along the length.

4 Conditions of manufacture

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

The wire shall be supplied without welds or other joints.

5 Surface configuration

The surface of the wire may be either plain, ribbed, grooved or indented. The purpose of the ribbed, grooved or indented surface is to improve bond properties between wire and concrete. The type of surface configuration shall be specified by the purchaser.

Examples of surface configurations are given in annex A.

6 Properties

6.1 Dimensions, masses and strength

Required properties and data for information of quenched and tempered wire are given in table 1.

Table 1 — Dimensions, masses and tensile properties of quenched and tempered wire

Surface configuration[1]	Nominal diameter[2]	Nominal tensile strength[1]	Nominal cross-sectional area	Mass per length		Characteristic		
				Minimum	Maximum	tensile strength[3] [4]	0,2 % proof stress[2] [5] [6]	0,1 % proof stress[2] [4] [5] [6]
mm		N/mm²	mm²	g/m	g/m	N/mm²	N/mm²	N/mm²
Plain	6,0	1 570	28,3	210	228	1 570 for all sizes	1 420 for all sizes	1 380 for all sizes
	7,0		38,5	285	310			
	8,0		50,3	373	404			
	10,0		78,5	582	631			
	12,2		117	867	941			
	14,0		154	1 143	1 239			
	16,0		201	1 491	1 617			
Ribbed	6,2	1 570	30,2	224	243	1 570 for all sizes	1 420 for all sizes	1 380 for all sizes
	7,2		40,7	301	327			
	8,0		50,3	373	404			
	10,0		78,5	582	631			
	12,0		113	838	909			
	14,0		154	1 143	1 239			
	16,0		201	1 491	1 617			
Grooved or indented	7,1	1 420	40	301	327	1 420 for all sizes	1 275 for all sizes	1 250 for all sizes
	9,0		64	482	522			
	10,7		90	679	735			
	12,6		125	942	1 020			

1) The nominal diameter, surface configuration and nominal tensile strength are for designation purposes only.

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

3) The tensile strength of any individual wire shall be calculated from the maximum force and the nominal cross-sectional area.

4) No single test result shall be less than 95 % of the specified characteristic value.

5) The proof stress shall be calculated from the proof force and the nominal cross-sectional area.

6) The characteristic 0,1 % and 0,2 % proof stresses are approximately 88 % and 90 % respectively of the specified characteristic tensile strength.

6.2 Elongation and ductility

The characteristic percentage total elongation at maximum force, A_{gt}, shall be not less than that specified in table 2.

Table 2 — Required characteristic elongation

Ductility class	Characteristic elongation, A_{gt} %
Duct 35	3,5
Duct 25	2,5

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

Wires with nominal diameters up to and including 10 mm shall withstand four bends without visible cracking, when exposed to the reverse bend test according to ISO 7801.

Larger wire sizes shall withstand one bend to between 160° and 180°, according to ISO 10065, without visible cracking. The mandrel diameter in the bend test shall be 10 times the nominal wire diameter.

6.3 Relaxation

The relaxation at 1 000 h at an initial stress of 70 % of the nominal tensile strength shall be determined.

If requested by the purchaser, the relaxation at 1 000 h shall also be determined at initial stresses of 60 % and 80 % of the nominal tensile strength.

The maximum relaxation values are listed in table 3.

Table 3 — Maximum relaxation values

Initial stress in percentage of nominal tensile strength	Relaxation class	
	Relax 1 %	Relax 2 %
70	4,0	2,0
60	2,0	1,0
80	9,0	4,5

6.4 Fatigue

If required by the purchaser, 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/mm^2 for plain wire and 180 N/mm^2 for ribbed, grooved or indented wire.

7 Designation

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

a) ISO 6934-3;

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

P: plain

R: ribbed

G: grooved

I: indented;

c) nominal diameter, in millimetres;

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

e) relaxation class (Relax 1 or Relax 2);

f) ductility class (Duct 35 or Duct 25).

EXAMPLE

Quenched and tempered plain wire of nominal diameter 7,0 mm with class 2 relaxation and class 25 ductility is designated:

ISO 6934-3 - P - 7,0 - 1 570 - Relax 2 - Duct 25.

8 Delivery conditions

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

8.1 Scale

The wire may be covered with a layer of scale.

8.2 Coil size

No specific requirements.

8.3 Curvature of quenched and tempered wires

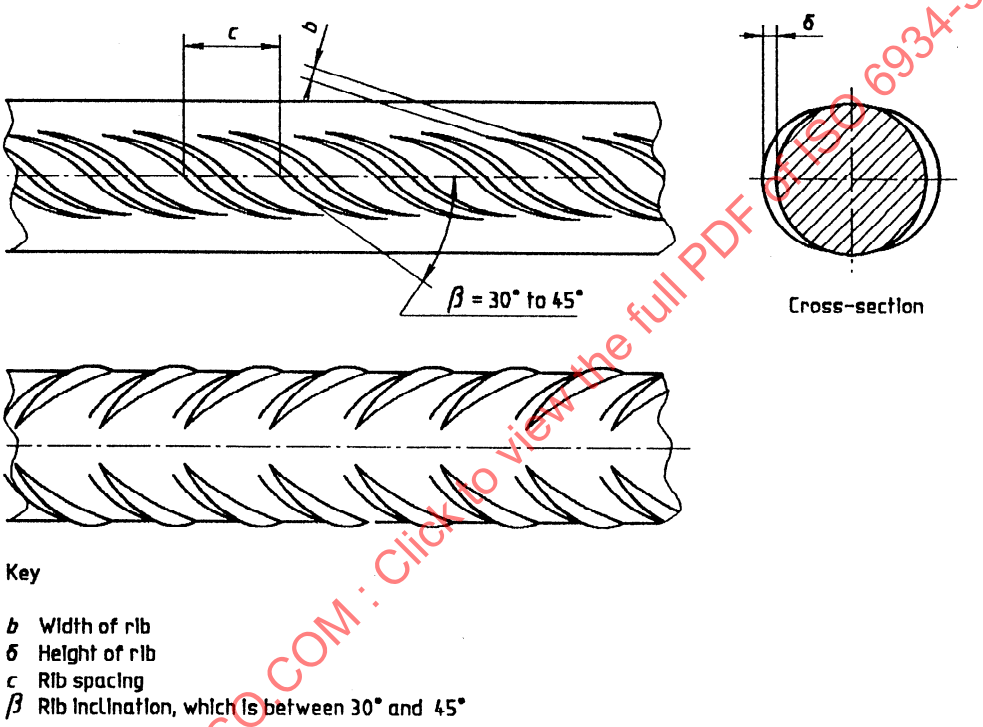
When a length of wire is lying free on a plain surface, the maximum bow height from a base line 1 m in length, measured from the inside of the curve, shall be not greater than 30 mm for any wire size.

Annex A
(informative)

Examples of surface configurations

A.1 Quenched and tempered, round ribbed wire

The example shown in figure A.1 indicates an arrangement of ribs.



Key

b Width of rib
δ Height of rib
c Rib spacing
β Rib inclination, which is between 30° and 45°

Figure A.1 — Quenched and tempered ribbed wire

Rib dimensions corresponding to different nominal wire diameters are given in table A.1.

Table A.1 — Rib dimensions

Dimensions in millimetres

Nominal wire diameter d_{nom}	Height δ	Width b	Length l	Spacing c
6,2	$0,4^{+0,1}_{0}$	0,6	9	6
7,2	$0,5^{+0,1}_{0}$	0,8	10	7
8,0	$0,5^{+0,1}_{0}$	0,8	15	8
10,0	$0,6^{+0,1}_{0,2}$	1,0	22	10
12,0	$0,7^{+0,1}_{-0,2}$	1,2	26	12
14,0	$0,9^{+0,2}_{0}$	1,4	30	14
16,0	$1,0^{+0,2}_{0}$	1,6	34	16

The minimum value for the specific projected rib area, A_r, is 0,033 for all diameters and is calculated using the formula

$$A_r = \frac{2 \times a_r \times \sin \beta}{\pi \times d_{nom} \times c}$$

where

a_r is the area of the longitudinal section of one rib;

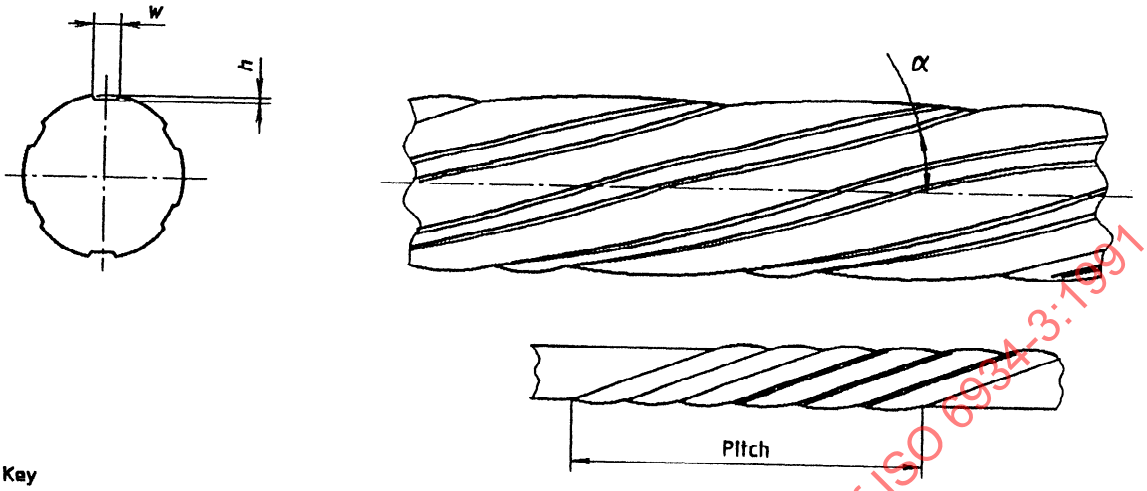
β is the rib inclination, which is between 30° and 45°;

d_{nom} is the nominal diameter of the wire;

c is the rib spacing (see figure A.1).

A.2 Quenched and tempered grooved wire

The example shown in figure A.2 indicates an arrangement of grooves.



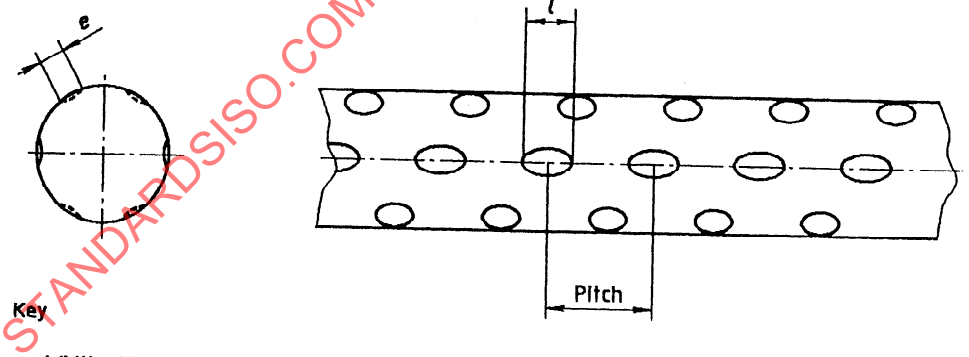
Key

w Width of groove
h Depth of groove
α Groove inclination

Figure A.2 — Quenched and tempered grooved wire

A.3 Quenched and tempered indented wire

The example shown in figure A.3 indicates an arrangement of indents.



Key

e Width of indent
l Length of indent

Figure A.3 — Quenched and tempered indented wire

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