INTERNATIONAL STANDARD

ISO

6934-4

Steel for the prestressing of concrete —

Part 4:
Strand

Acier pour armatures de précontrainte —

Partie 4: Torons

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 6934-4 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*

Steel for the prestressing of concrete —

Part 4:
Strand

1 Scope

This part of ISO 6934 specifies requirements for high tensile steel strand which has been given a stress relieving heat treatment according to the general requirements specified in ISO 6934-1. The strand may contain either 2, 3, 7 or 19 individual wires.

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

3.1 compacted strand: A strand which has been compressed (e.g. by cold working after stranding) and given a stress-relieving treatment before winding into coil form.

4 Conditions of manufacture

4.1 Steel

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

4.2 Stress-relieving heat treatment

The strand shall be subjected to a low temperature heat treatment as a continuous linear process by uncoiling and running the strand through a suitable form of heating (see ISO 6934-1).

The strand shall be rewound into coils or onto reels having a core diameter which is sufficiently large to ensure that the strand shall be reasonably straight when uncoiled (see 8.2).

Strand forming operations and the stress relieving treatment shall ensure that the wires do not unravel when the strand is cut. However, if unravelled, it shall be possible to put them back into position without difficulty.

4.3 Compacted strand

The 7-wire strand shall comply with 4.4 before drawing.

After drawing and stress-relieving treatment, the strand shall have a pitch of 14 to 18 times the nominal strand diameter.

4.4 Welds

4.4.1 2-wire and 3-wire strand

The wire from which the strand is fabricated shall not contain welds.

4.4.2 7-wire and 19-wire strand

There shall be no strand joints, or strand splices in any length of the completed strand, unless specifically agreed by the purchaser.

During the process of manufacture of individual wires for stranding, welding is permitted only prior to or at the size used during the last thermal treatment. There shall be no welds in the wire after it has been drawn through the first die in the wire drawing.

If agreed upon by the purchaser, butt-welded joints may be made in the individual wires during fabrication of the strand, provided there is not more than one such joint in any 45 mm section of the completed strand.

4.5 Cracks

Longitudinal cracks with a depth less than 4 % of the diameter of the component wires shall not be considered as defects.

5 Strand construction

The following requirements apply in addition to those of ISO 6934-1.

In 2-wire and 3-wire strand, the individual wires shall be of the same nominal size and the pitch shall be 12 to 22 times the nominal strand diameter.

In 7-wire strand, the diameter of the straight centre-wire shall be at least 2 % greater than the diameter of the outer helical wires. The latter shall be tightly spun around the centre wire, with a pitch between 12 and 18 times the nominal strand diameter.

The direction of lay is subject to agreement between supplier and purchaser.

In 19-wire strand the construction shall be 9 + 9 + 1 Seale or 12 + 6 + 1 spiral strand, and the pitch shall be 12 to 22 times the nominal strand diameter.
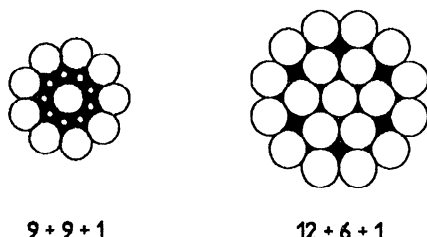

9 + 9 + 1   12 + 6 + 1

Figure 1 — Typical 19-wire strand constructions

6 Properties

6.1 Dimensions, masses and strength of strand

Required properties and data for information of strand are given in table 1.

6.2 Elongation and ductility

The characteristic percentage total elongation at maximum force, A_{gt}, shall be not less than 3,5 %.

6.3 Relaxation

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

If requested by the purchaser, the relaxation at 1 000 h shall also be determined at initial forces of 60 % and 80 % of the characteristic maximum forces specified in table 1.

The maximum relaxation values are listed in table 2.

6.4 Fatigue

If agreed between purchaser and manufacturer, the strands 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 195 N/mm^2 for all strands.

Table 1 — Dimensions, masses and tensile properties of strand

Type of strand[1] Diameters mm	Nominal strand diameter[1] mm	Nominal tensile strength[1] [2] N/mm²	Nominal cross-sectional area[2] mm²	Mass per length Nominal g/m	Permissible deviation %	maximum force[2] [3] [4] kN	Characteristic 0,1 % proof force [3] [4] [5] kN	0,2 % proof force[4] [5] kN
2-wire								
2 × 2,90	5,8	1 910	13,2	104		25,2	21,4	22,3
3-wire								
3 × 2,40	5,2	1 770	13,6	107		24,0	20,4	21,1
		1 960				26,7	22,7	23,5
3 × 2,90	6,2	1 910	19,8	155		37,8	32,1	33,2
3 × 3,50	7,5	1 770	29,0	228		51,2	43,5	45,0
		1 860				54,0	45,9	47,0
7-wire ordinary	9,3	1 720	51,6	405	+4 −2 for all strands	88,8	72,8	75,4
	9,5	1 860	54,8	432		102	83,6	86,6
	10,8	1 720	69,7	546		120	98,4	102
	11,1	1 860	74,2	580		138	113	117
	12,4	1 720	92,9	729		160	131	136
	12,7	1 860	98,7	774		184	151	156
	15,2	1 720	139	1 101		239	196	203
	15,2	1 860	139	1 101		259	212	220
7-wire compacted	12,7	1 860	112	890		209	178	184
	15,2	1 820	165	1 295		300	255	264
	18,0	1 700	223	1 750		380	323	334
19-wire	17,8	1 860	208	1 652		387	317	329
	19,3	1 860	244	1 931		454	372	386
	20,3	1 810	271	2 149		491	403	417
	21,8	1 810	313	2 482		567	465	482

1) The type of strand, nominal diameter and nominal tensile strength are for designation purposes only.

2) The nominal tensile strength is calculated from the nominal cross-sectional area and the specified characteristic maximum force (see footnote 5).

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

4) Considering the small tolerance on mass per length, characteristic forces have been specified rather than stresses.

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

Table 2 — 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

7 Designation

The strand shall be ordered in accordance with ISO 6934-1, and be designated as follows:

a) ISO 6934-4;

b) type of strand (see table 1);

c) nominal diameter, in millimetres;

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

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

f) direction of lay.

EXAMPLES

7-wire ordinary strand of nominal diameter 12,7 mm and nominal strength 1 860 N/mm^2 with class 2 relaxation and right-hand lay is designated:

ISO 6934-4 - 7-wire ordinary - 12,7 - 1 860 - Relax 2 - right.

3-wire strand of nominal diameter 5,2 mm and nominal strength 1 770 N/mm^2 with class 1 relaxation and left-hand lay is designated:

ISO 6934-4 - 3-wire - 5,2 - 1 770 - Relax 1 - left.

8 Delivery conditions

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

8.1 Coil size

The preferred coil dimensions are:

Internal diameter: 800 mm ± 60 mm or
950 mm ± 60 mm

Width: 600 mm ± 50 mm or
750 mm ± 50 mm

The manufacturer shall state the dimensions of his coils.

8.2 Curvature of strand

When a length of strand is lying free on a flat surface, the maximum bow height from a base line of length 1 m, measured to the inside of the curve, shall be not greater than 25 mm.

This page intentionally left blank