Technical Prescriptions	PTV	314
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Prestressing steels

Cold drawn wires

The valid version is available on the PROCERTUS extranet STEEL: extranet-steel.procertus.be/en/.

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DOCUMENTS TO BE CONSULTED

In principle, the latest edition of the standards and PTV applies. If necessary, an addendum to this PTV will be issued in case of incompatibility following the revision of one of the documents listed below.

Standards

- NBN I 10-001, Prestressing steels – Wires, strands and bars – Generalities and common requirements
- NBN I 10-002, Prestressing steels – Cold drawn wires
- NBN I 10-003, Prestressing steels – Strands
- NBN I 10-201, Prestressing steel products – Determination of the bond behaviour of prestressing steel to concrete
- NBN EN ISO 15630-3, Steel for the reinforcement and prestressing of concrete – Test methods – Part 3: Prestressing steel

Technical Prescriptions

- PTV 311 – Prestressing steels – Strands
- PTV 312 – Galvanized prestressing steels
- PTV 314 – Prestressing steels – Cold drawn wires

FOREWORD

These Technical Prescriptions (PTV) have been drawn up by the Sectoral Commission Steel for reinforced concrete and for prestressing (SC ST1) on the basis of a consensus within the sector. SC ST1 is the consultative body within PROCERTUS where the various stakeholders in this sector are represented:

- public sector users;
- private sector users;
- manufacturers;
- experts;
- suppliers.

The purpose of these PTV is to standardise and, where necessary, supplement the technical requirements for cold drawn wires in construction practice in Belgium. They serve as reference technical prescriptions for defining the characteristics of products with a view to their suitability for use in structures or parts of structures.

These PTV support both the private and public construction sectors in drawing up tender documents, awarding contracts and carrying out technical assessments of products. In the context of risk management, these requirements may be regarded as rules of good professional practice. Their content is tailored to the specific needs of the various stakeholders in the sector.

These PTV take account of the current European framework for construction products and, where applicable, comply with harmonised technical specifications and the terminology used therein. The provisions of these PTV are fully compatible with CE marking.

Furthermore, these PTV contain the provisions necessary to manage the risks associated with the use of the products, including the interaction between the various construction elements and the durability of the structure.

These PTV are not regulatory in nature, but may be made applicable, in whole or in part, by contractual means, in particular through specifications or other contractual documents.

Purchasers or users may require evidence of compliance with these PTV. This may be provided through batch approval or product certification in accordance with standard NBN EN ISO/IEC 17067 (such as the BENOR mark).

Such certification confirms that the product complies with the requirements of these PTV. Where applicable, this is independent of the CE marking, which relates exclusively to the placing of products on the market and the performance declared by the manufacturer in accordance with the applicable harmonised technical specifications.

1 SUBJECT AND SCOPE

These Technical Prescriptions specify the requirements with which the cold drawn wires shall comply. Compliance relates to the requirements of the NBN I 10-001 and I 10-002 standards series, supplemented by the clarifications, modifications and additions described in these Technical Prescriptions.

2 CLARIFICATIONS, MODIFICATIONS AND ADDITIONS RELATING TO NBN I 10-001

2.1 Clause 1 – Scope

The properties specific to each type of prestressing steel product are specified in the following standards or technical prescriptions: NBN I 10-002, NBN I 10-003, PTV 311, PTV 312, PTV 314.

2.2 Clause 2.1.1 – Definitions

- Smooth galvanised wire: the definition is given in PTV 312.

2.3 Clause 2.4 – Nominal cross-sectional area

The nominal cross-sectional area is that used for the calculation of the mechanical characteristics.

2.4 Clause 4.1 – Conventional designation

The conventional designation of smooth galvanised wire is given in PTV 312.

2.5 Clause 5 – Geometrical properties

The nominal diameters, their tolerances and the straightness of the different products are specified in standards NBN I 10-002 and NBN I 10-003, unless modified by PTV 311 and 314.

In the case of galvanised products according to PTV 312, the geometrical properties apply to the product including the zinc coating.

2.6 Clause 6 – Mechanical properties

The mechanical properties of the different products are specified in standards NBN I 10-002 and NBN I 10-003, unless modified by PTV 311 and 314.

In the case of galvanised products according to PTV 312, the mechanical properties apply to the product including the zinc coating.

2.7 Clause 6.2 – Breaking force or tensile strength

The tensile strength is expressed in N/mm²; it is calculated from the breaking forces and the actual cross-sectional areas (NBN EN ISO 15630-3).

The actual cross-sectional areas are determined as follows:

- in the case of a smooth wire: calculation based on the arithmetic mean of two diameter measurements along two perpendicular axes. The possible presence of a zinc coating is not taken into account.

- in the case of an indented wire: calculation based on the measurement of the length and the mass of the product. The possible presence of a zinc coating is not taken into account.

The actual cross-sectional area is calculated with an accuracy of ± 1 %.

2.8 Clause 6.3 – Yield force

The yield force shall be determined graphically on the force–elongation diagram in accordance with NBN EN ISO 15630-3.

2.9 Clause 6.5 – Modulus of elasticity

The modulus of elasticity (E) shall be determined from the force–elongation diagram in accordance with NBN EN ISO 15630-3.

2.10 Clause 7.4 – Stress corrosion

Resistance to stress corrosion shall be determined by the test described in NBN EN ISO 15630-3 using solution A. The test shall be carried out under a load equal to 80 % of F'm. The test shall be carried out on the bare product.

3 CLARIFICATIONS, MODIFICATIONS AND ADDITIONS RELATING TO NBN I 10-002

3.1 Clause 4 – Control

Control shall be carried out in accordance with:

- NBN I 10-002, amended by PTV 314, for bare products
- PTV 312 for galvanised products

3.2 Clause 4.1 – Verifiable properties

- n° 1 Geometrical properties (diameter, nominal cross-sectional area and, where applicable, characteristics of indentations)

3.3 Clause 4.2.7 – Time depending behaviour

The frequency of the relaxation tests (No. 10), fatigue tests (No. 11) and stress corrosion tests (No. 12) shall be specified at the time of ordering. The frequency of the tests shall at least reach the minimum frequency stated in TRA 282. By special agreement at the time of ordering, the producer shall communicate test results obtained on steels of the same type, for property No. 13.

3.4 Clause 5.1 – Properties

Table 4 of standard NBN I 10-002 is supplemented by the properties of the following cold drawn wires:

- smooth wire ∅ 4 - 1860 - R2 ;
- indented wire ⊗ 4 - 1860 - R2 ;
- smooth wire ∅ 5 - 1860 - R2 ;
- indented wire ⊗ 5 - 1860 - R2 ;

- smooth wire ∅ 4,5 - 1770 - R2 ;
- indented wire ⊗ 4,5 - 1770 - R2 ;
- smooth wire ∅ 7,5 - 1670 - R2 ;
- indented wire ⊗ 7,5 - 1670 - R2 ;
- smooth wire ∅ 5 - 1570 - R2 ;
- indented wire ⊗ 5 - 1570 - R2 ;
- smooth wire ∅ 9,4 - 1570 - R2 ;
- indented wire ⊗ 9,4 - 1570 - R2.

Table 4 completed accordingly is given below.

The properties of smooth wires specified in Table 4bis below apply both to bare wires and to galvanised wires (see also PTV 312).

In the case of galvanised wires, the specified properties apply to the wire including the zinc coating.

Table 4bis – Properties of stress-relieved cold drawn wires

										Reverse bendings			Maximum relaxation at 1000 h				
Nominal diameter (mm)	Characteristic tensile strength (N/mm²) min	Nominal cross-sectional area Sn (mm²)	Nominal mass per metre (g/m)	Permissible deviation on diameter (mm)	Permissible deviation on cross-sectional area (mm²)	Permissible deviation on mass (g/m)	Characteristic value of tensile strength (kN) min	Characteristic value of 0,2 % yield strength (kN) min	Characteristic value of 0,1 % yield strength (kN) min	Minimum number of smooth wires	Minimum number of indented wires	Support radius (mm)	Initial load (% of actual breaking force)	R1 (%) max	R2 (%) max	Fatigue test, stress range (Fmax – Fmin) for Fmax = 0,8 F'm (N)	Stress corrosion at 80 % of Fm – minimum duration (h)
(1)	(2, 12)	(7)					(12)	(12)	(12)							(3)	(8)
12.2	1470	117	918	0.07	1.34	10.5	172	141	138			30					
12.2	1570	117	918	0.07	1.34	10.5	184	161	161			30					
10	1470	78.5	617	0.07	1.10	8.6	115	94.3	92.3			25					
10	1570	78.5	617	0.07	1.10	8.6	123	108	108			25					
9.4	1570	69.4	545	0.07	1.00	7.9	109	95.8	95.8			25					
8	1570	50.3	395	0.06	0.75	5.9	79.0	69.4	69.4			20					
8	1670	50.3	395	0.06	0.75	5.9	84.0	73.9	73.9			20					
7.5	1670	44.2	347	0.06	0.66	5.4	73.8	65.0	65.0			20					
7	1570	38.5	302	0.05	0.55	4.3	60.4	53.1	53.1			20	60	4.5	1	200 × So for smooth strands 180 × So for indented strands	individual: 2 h 00 min median: 5 h 00 min
7	1670	38.5	302	0.05	0.55	4.3	64.3	56.6	56.6			20					
7	1770	38.5	302	0.05	0.55	4.3	68.2	59.7	59.7	4	3	20	70	8	2.5		
6	1670	28.3	222	0.05	0.47	3.7	47.3	41.6	41.6			15					
6	1770	28.3	222	0.05	0.47	3.7	50.1	43.9	43.9			15	80	12	4.5		
5	1570	19.6	154	0.05	0.39	3.1	30.8	27.1	27.1			15					
5	1670	19.6	154	0.05	0.39	3.1	32.7	28.8	28.8			15					
5	1770	19.6	154	0.05	0.39	3.1	34.7	31.0	31.0			15					
5	1860	19.6	154	0.05	0.39	3.1	36.5	32.5	32.3			15					
4.5	1770	15.9	125	0.04	0.32	2.5	28.1	24.7	24.7			15					
4	1670	12.6	98.6	0.04	0.25	2	21.0	18.5	18.5			10					
4	1770	12.6	98.6	0.04	0.25	2	22.3	19.5	19.5			10					
4	1860	12.6	98.6	0.04	0.25	2	23.4	21.0	20.8			10					

F'm / F'p0,2 min (3): 1.025
Characteristic value of F'm / F'p0,1 min (3, 13): 1.08
Characteristic elongation at maximum force Lo ≥ 100 mm (%) min (4, 13): 3.5
Minimum reduction of area at fracture (%): 25

(1) Diameters not listed are not standardised.
(2) The specified characteristic tensile strength is calculated from the nominal cross-sectional area of the prestressing steel and the specified characteristic breaking force.
(3) F'm, F'p0,1, F'p0,2 = breaking force, 0,1 % and 0,2 % proof force, measured by tensile test.
(4) Lo = initial gauge length (according to NBN EN ISO 15630-3).
(5) So = actual cross-sectional area of a straight section before application of the load, determined by a weighing method with a maximum error of 0,4 %.
(7) The cross-sectional area is calculated assuming a density of 7,85 kg/dm³.
(8) The measurement is carried out in hours and minutes and shall be rounded to the nearest multiple of 10 minutes, for example: 4h52min = 4h50min < 5h00min and 4h56min = 5h00min.
NOTE: The value of the modulus of elasticity may be taken as E = 205 kN/mm² ± 10 kN/mm², unless otherwise specified by the producer.
(12) The characteristic value is determined as the 5 % fractile with a confidence level of 95 %.
(13) The characteristic value is determined as the 10 % fractile with a confidence level of 95 %.

4 HISTORY OF REVISIONS

Revisions 0 to 4: creation, adaptations

Revision 5:

- reference to BENOR asbl
- density equal to 7,85 kg/dm³

Revision 6: Table 4bis, diameters 5 and 7 mm

Revision 7: transfer from OCAB to PROCERTUS

Revision 8: addition of Clause 1, modification of Table 4bis in Clause 3.4 (alignment with EN 1992-1-1, including the addition of the requirement relating to F'm / F'0,1 and the adaptation of the characteristic values of 0,1 % yield strength)