

BS 5896:2012



BSI Standards Publication

High tensile steel wire and strand for the prestressing of concrete – Specification

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 24, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 May 2012. It was prepared by Technical Committee ISE/104, *Concrete reinforcing and prestressing steels*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 5896:1980, which is withdrawn.

Relationship with other publications

This standard has been revised to follow BS EN 10138-1 (in preparation). Definitions, symbols, steelmaking and manufacturing processes, routine inspection and testing, test methods, identification of the manufacturer and technical class and verification of mechanical properties in the case of dispute may be taken from BS EN 10138-1, when published.

CEN Derogation from standstill

The European Committee for Standardization (CEN) have granted derogation from standstill to permit BSI to publish this British Standard as a UK national standard. This derogation is to enable the continued production of steel products for the prestressing of concrete, incorporating the latest products on the UK market, and for reasons of product safety and has been granted until publication of the BS EN 10138 series.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This British Standard specifies general requirements for uncoated high tensile strength steel products, which are used widely for the prestressing of concrete and are also used for other tensile applications in the construction field. The standard applies only to products as supplied by the producer.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 10020, *Definition and classification of grades of steel*

BS EN 10027-1, *Designation systems for steels – Part 1: Steel names*

BS EN 10027-2, *Designation systems for steels – Part 2: Steel numbers*

BS EN ISO 15630-3, *Steel for the reinforcement and prestressing of concrete – Test methods – Part 3: Prestressing steel*

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

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

3 Terms and definitions

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

3.1 product type

specific delivery form of prestressing steel

NOTE See Table A.1.

3.2 wire rod

hot rolled steel delivered in coils, used for cold working treatments such as wire drawing

3.3 wire

product manufactured by cold working wire rod that is in a suitable metallurgical condition for cold working and which is given a final thermo-mechanical treatment

NOTE The surface of the wire is plain or indented. It may be covered by a residue of drawing lubricant. The wire is wound into large diameter coils (see 10.3) or delivered in bundles of cut lengths.

3.4 strand

product consisting of a number of cold drawn wires spun together in the same direction and with the same lay length that is given a final thermo-mechanical treatment and is then wound into large diameter coils (see 10.3)

NOTE The common types of strands are as follows:

- a) 7-wire strand: a straight core wire around which are spun six wires in one layer;
- b) 7-wire compacted strand: 7-wire strand that has been drawn through a die, or compressed by other means, before the final thermo-mechanical treatment;

- c) *7-wire indented strand: strand produced from indented wires. The central wire of 7-wire indented strand may be plain with no indentations.*

3.5 unit of manufacture

quantity of product of the same nominal diameter, surface configuration and technical class (strength class) that is manufactured according to specified manufacturing conditions

NOTE The physical limits on the unit of manufacture depend on each product type, see 8.2.2.1.

3.6 unit of product

quantity of product coming from a subdivision of a unit of manufacture, generally in the form as delivered to a customer

NOTE The physical limits on the unit of product depend on each product type, see 8.2.2.1.

3.7 unit of inspection

quantity of product coming from a unit of manufacture and presented at any one time for examination and release purposes

NOTE The physical limits on the unit of inspection depend on each product type, see 8.2.2.1.

3.8 consignment (delivery batch)

total amount of the product in the same delivery to a customer, which may consist of products coming from several units of manufacture

3.9 characteristic value

value having a prescribed probability of not being attained in a hypothetical unlimited test series

NOTE In the context of this British Standard the characteristic value is (unless otherwise indicated) the lower limit of the statistical tolerance interval at which there is a 95% probability ($1 - \alpha = 0.95$) that 95% ($p = 0.95$) of the values are at or above this lower limit. This definition refers to the long-term quality level of production.

3.10 inspection

conformity evaluation by observation and judgement accompanied as appropriate by measurement, testing or gauging

3.11 product family

group of products of the same type and same technical class (strength class) (see Annex A)

NOTE Their surface configuration may vary, e.g. plain or indented.

3.12 factory production control

permanent internal production control exercised by the manufacturer

3.13 standard properties

properties prescribed in this British Standard as part of the factory production control requirements for every unit of inspection

3.14 special properties

properties prescribed in this British Standard that are not determined as part of the factory production control requirements for every unit of inspection

3.15 maximum value

value which no test result shall exceed

3.16 minimum value

value below which no test result shall fall

3.17 production or manufacturing site

site at which the product is produced

3.18 testing laboratory

laboratory carrying out the various tests required to evaluate the products

NOTE It may be located at the manufacturer's production area, located on the manufacturer's site or located remote to the manufacturer's site independent to the manufacturer.

3.19 heat of steel

quantity of steel corresponding to the same single melting operation identified by a single number so designated by the steel manufacturer(s)

3.20 median

average value of the third and fourth test result from the ordered series of results of six corrosion tests

3.21 threshold level

quantitative expression of the behaviour of a construction product, for an action to which it is subject or which it generates under the intended use conditions

3.22 threshold value

quantitative expression of the limiting value of a construction product, for an action to which it is subject or which it generates under the intended use conditions

3.23 indentation length

length of individual indentations measured in the direction of the wire axis

3.24 indentation depth

maximum depth of individual indentations measured radially from wire surface

3.25 indentation spacing

distance between the centre of two successive indentations measured (or taken) in the direction of the wire axis (see Figure 2 and Figure 3)

3.26 average diameter

average of the diameters measured in two perpendicular directions, one of which is the maximum diameter found by inspection

3.27 ovality

difference between maximum and minimum diameters

4 Symbols

The symbols used in this British Standard and the corresponding designations are given in Table 1.

Table 1 Symbols and corresponding designations

Symbol	Unit	Designation
a	mm	Depth of the indentations
A_{gt}	%	Specified minimum value of percentage total elongation at maximum force
c	mm	Indentation spacing
C_v	kN	Specified characteristic value for maximum force or 0.1% proof force
d	mm	Nominal diameter of the product
d_{sw}	mm	Nominal diameter of a constitutive wire of a strand
D	%	Maximum permitted value of the average coefficient of reduction of the maximum force in the deflected tensile test
D_i	mm	Minimum internal diameter of a coil of wire or strand
E	GPa	Modulus of elasticity
f	Hz	Frequency of load cycles in the axial load fatigue test
F_m	kN	Specified characteristic value of maximum force
$F_{m'_{max}}$	kN	Specified maximum value of maximum force
$F_{p0.1}$	kN	Specified characteristic value of 0.1% proof force
F_{ma}	kN	Actual maximum force, in the tensile test, determined on a test piece adjacent to the test piece submitted to special property test
F_{up}	kN	Upper force in the axial load fatigue test
F_r	kN	Force range in the axial load fatigue test
l	mm	Length of indentation
k	—	Coefficient function of the number of test results
L_0	mm	Original gauge length of the extensometer for the determination of A_{gt}
m	g	Mass of the test piece
M	g/m	Nominal mass per metre of the product
m_r	kN	Average value of the test results for maximum force or 0.1% proof force
n	—	Number of test results for maximum force or 0.1% proof force
r	mm	Mandrel radii for bend test machine
R_m	MPa	Nominal tensile strength
s	kN	Estimated standard deviation of the test results for maximum force or 0.1% proof force
S_n	mm ²	Nominal cross-sectional area of the product
α	—	Statistically reliable failure rate
σ	—	Force ratio, i.e. the ratio of the actual maximum force divided by the actual 0.1% proof force, as determined in the tensile test

NOTE 1 MPa = 1 N/mm²

5 Classification and designation

5.1 Classification

All steels covered by this British Standard shall be classified as special steels according to BS EN 10020.

5.2 Designation

The products covered by this British Standard shall be designated as given in this specification.

6 Information to be obtained by the manufacturer

The following information shall be obtained by the manufacturer at the time of enquiry and order:

- designation of the product in accordance with 5.2;
- the packaging and protection requirements and in the case of products supplied in bundles, the maximum mass of the individual bundle;
- the requirements concerning information to accompany the delivery (e.g. delivery note, type of inspection document [see BS EN 10204], copies of force/extension diagrams);
- special requirements for labeling;
- strand lay direction;
- nominal depth of indentations for indented wire.

7 Requirements

7.1 General

7.1.1 Steel making processes

The steel may be made by any process, except that air or mixed air-oxygen bottom blown processes shall not be used.

7.1.2 Primary incoming materials

The primary products (billets, wire rod) shall be manufactured according to 7.1.1 and associated processes which will ensure products fully conform to requirements. The wire rod shall conform to BS EN ISO 16120-1 and BS EN ISO 16120-4.

7.1.3 Freedom from defects

The finished product shall be free from any defects likely to impair its performance.

Products with rusted steel shall not be supplied unless the rust is a thin film. The underlying steel surface shall appear to be smooth to the unaided eye.

7.1.4 Welds

Wire shall contain no welds in the product as supplied by the manufacturer. Strands with normal production lengths may contain welds made in the individual wires before cold drawing, but shall not contain any welds made during or after cold drawing. Not more than one weld in any component wire shall be permitted in any 50 m of strand.

7.2 Standard properties

7.2.1 Geometrical properties

The geometrical properties shall be defined by a nominal diameter (d), a nominal cross-sectional area (S_n) and a nominal mass per metre (M). In addition, for indented wire, geometrical properties shall be defined by the nominal dimensions of indentations and for strands, geometrical properties shall be defined by the lay length.

The requirements for the surface configuration of the product and the product straightness shall be as given in Clause 11 and Clause 12.