

Steel wire for the reinforcement of concrete products — Specification

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Committees responsible for this British Standard

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- British Coatings Federation
- British Precast Concrete Federation
- Concrete Society
- Department of Transport — Highways Agency
- Galvanizers Association
- Institution of Structural Engineers
- UK Certification Authority for Reinforcing Steels
- UK Steel Association

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Foreword

This British Standard has been prepared by Subcommittee ISE/9/1, and is a revision of BS 4482:1985, which will be withdrawn on 1 January 2006. This edition incorporates a full revision of the standard. The standard now contains provisions for plain, indented and ribbed wire. Requirements are also specified for any of these wires in the decoiled condition. The characteristic strength has been increased to 500 MPa, and ductility requirements have been aligned with grade B500A of BS 4449:2005.

The start and finish of text introduced by Amendment No. 1 is indicated in the text by tags **A1** and **A1**.

For sizes up to and including 12 mm in coil, plain round wire of grade 250 MPa is now covered by this standard. For larger sizes, for example for dowel bar applications, reference should be made to BS EN 10025-1. For dowel bars for use in concrete pavements, reference should be made to BS EN 13877-3.

This standard has been written so that it can be used in conjunction with BS EN 10080:2005. 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 are all taken from BS EN 10080:2005.

BS EN 10080:2005 does not define steel grades or technical classes, and requires that technical classes should be defined in accordance with BS EN 10080:2005, by specified values of R_e , R_m/R_e , A_{gt} , R_{eact}/R_{enom} (where appropriate), fatigue strength (where required), bend performance, weldability, bond strength, tolerances and dimensions. All wires in this standard meet the requirements of BS EN 10080:2005. No fatigue performance is specified.

BS EN 10080:2005 contains an informative Annex ZA, which describes how that standard can be used for the purposes of CE marking of reinforcing steels. Annex ZA and 8.2, 8.3 and 8.4 of BS EN 10080:2005 relate to the role of the notified body in assessing products for an EC certificate of conformity, and as such are not included in this standard. It is not a requirement of this British Standard that materials produced to it should meet the requirements for CE marking.

Where CE marking is required for the purposes of complying with the EU Construction Products Directive, reference ought to be made to BS EN 10080:2005.

Wires to this standard in sizes 8 mm and above meet the A class ductility of Annex C of BS EN 1992-1-1:2004, although this design code relates only to ribbed steels, and not plain or indented.

To avoid confusion, it is recommended that where wire is required for applications covered by BS EN 1992-1-1:2004, material should be specified to BS 4449:2005, and not to this standard. Similarly, this standard should not be used to specify wire for the manufacture of structural welded fabric according to BS 4483. In this case, material should be specified to BS 4449:2005.

This standard comes into effect on 1 January 2006.

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.

Summary of pages

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

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1 Scope

This British Standard specifies requirements for plain, indented and ribbed steel wire used for the reinforcement of concrete products.

The standard contains provisions for two grades, based on mechanical properties. Grade 500 is specified for plain, indented and ribbed wires. Grade 250 is specified as an option for plain wires only.

Bar or coil for the manufacture of structural welded fabric to BS 4483 is not covered by this standard. BS 4449:2005 covers bar or coil for this purpose.

Wire for the prestressing of concrete and wire used for ties, lifting and other general engineering or industrial purposes is not covered by this standard.

The nominal wire diameter (size) range specified in this standard is 2.5 mm to 12 mm.

2 Normative references

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

BS 4449:2005, *Steel for the reinforcement of concrete — Weldable reinforcing steel — Bar, coil and decoiled product — Specification*.

BS 4483, *Steel fabric for the reinforcement of concrete*.

BS EN 1766:2000, *Products and systems for the protection and repair of concrete structures — Test methods — Reference concretes for testing*.

BS EN 1992-1-1:2004, *Eurocode 2: Design of concrete structures — General rules for buildings (together with United Kingdom National Application Document)*.

BS EN 10020:2000, *Definition and classification of grades of steel*.

BS EN 10027-1, *Designation systems for steel — Steel names, principal symbols*.

BS EN 10079, *Definition of steel products*.

BS EN 10080:2005, *Steel for the reinforcement of concrete — Weldable reinforcing steel — General*.

BS EN 12390-3, *Testing hardened concrete — Part 3: Compressive strength of test specimens*.

BS EN ISO 15630-1:2002, *Steel for the reinforcement and prestressing of concrete — Test methods — Part 1: Reinforcing bars, wire rod and wire*.

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS EN 10020, BS EN 10027-1 and BS EN 10079 and the following (some of which are taken from BS EN 10080:2005) apply:

3.1

reinforcing steel

steel product with a circular or practically circular cross-section which is suitable for the reinforcement of concrete

3.2

ribbed reinforcing steel

reinforcing steel with at least two rows of transverse ribs, which are uniformly distributed over the entire length

3.3

longitudinal rib

uniform continuous protrusion parallel to the axis of the wire

3.4

transverse rib

rib on the surface of the wire other than a longitudinal rib

3.5

rib height

h

distance from the highest point of the rib (transverse or longitudinal) to the surface of the core, to be measured normal to the axis of the wire

3.6

rib spacing

indentation spacing

c

distance between the centres of two consecutive transverse ribs or two consecutive indentations measured parallel to the axis of the wire

3.7

angle of transverse rib or indentation inclination

β

angle between the axis of the transverse rib or indentation and the longitudinal axis of the wire

3.8

transverse rib flank inclination

α

angle of the rib flank measured perpendicular to the longitudinal axis of the rib

NOTE Figure 1.

3.9

relative rib area

f_R

area of the projection of all ribs on a plane perpendicular to the longitudinal axis of the wire, divided by the rib spacing and the nominal circumference

3.10

indented reinforcing steel

reinforcing steel with defined indentations uniformly distributed over the entire length

3.11

indentation depth

t

distance between the surface of the wire and the deepest point of the indentation

3.12

indentation width

b

width of the indentation to be measured parallel to the axis of the wire

3.13

plain reinforcing steel

reinforcing steel with a smooth surface

3.14

coil

single length of wire wound in concentric rings

3.15

decoiled product

reinforcing steel manufactured in coils and subsequently straightened for further processing

3.16**nominal cross-sectional area** A_n

cross-sectional area equivalent to the area of a circular plain wire of the same nominal diameter, d (i.e. $\frac{\pi d^2}{4}$)

3.17**welded fabric**

arrangement of longitudinal and transverse bars, rods or wires of the same or different nominal diameter and length that are arranged substantially at right angles to each other and factory electrical resistance welded together by automatic machines at all points of intersection

3.18**characteristic value**

value of a material or product property having a prescribed probability of not being attained in a hypothetical unlimited test series

NOTE 1 This value generally corresponds to a specific fractile of the assumed statistical distribution of the particular property of the material or product.

NOTE 2 A nominal value is used as the characteristic value in some circumstances.

3.19**minimum value**

value below which no test result shall fall

3.20**maximum value**

value which no test result shall exceed

3.21**batch**

quantity of wires or decoiled products of one nominal diameter and one cast produced by one manufacturer and presented for examination at any one time

3.22**semi-finished product**

product which requires further processing in order to achieve the standard and special properties specified

3.23**standard property**

property which is part of the routine inspection and test requirements for every test unit

3.24**technical class**

type of steel defined by its performance characteristics, identified by a unique product number

4 Symbols

A list of symbols used in this standard, reproduced from BS EN 10080:2005, is given in Table 1.

Table 1 — List of symbols

Symbol	Description	Unit
A_n	Nominal cross-sectional area	mm ²
A_{gt}	Percentage total elongation at maximum force	%
b	Width of indentation	mm
c	Transverse rib or indentation spacing	mm
C_{eq}	Carbon equivalent value (CEV)	% by mass
C_v	Specified characteristic value	^a
d	Nominal diameter of the reinforcing steel	mm
e	Gap between rib or indentation rows	mm
f_R	Relative rib area	—
f_P	Relative indentation area	—
h	Rib height	mm
k	Coefficient as a function of the number of test results	—
$\bar{x}$	Average value of test results	^a
R_e	Yield strength	MPa ^b
R_{eH}	Upper yield strength	MPa ^b
R_m	Tensile strength	MPa ^b
R_m/R_e	Ratio tensile strength/yield strength	—
$R_{p0.2}$	0.2 % proof strength, non proportional extension	MPa ^b
s	Estimate of the standard deviation	^a
α	Transverse rib flank inclination	degrees
β	Angle of transverse rib or indentation inclination	degrees
a_1, a_2, a_3, a_4	Increment (specified in the product specification)	^a
t	Depth of indentation	mm
b	Width of the beam (beam test)	mm
d_m	Mandrel diameter (beam test)	mm
F_a	Total force applied (beam test)	kN
F_i	Force in hinge and bar or wire (beam test)	kN
σ_s	Stress in the bar or wire (beam test)	MPa ^b
τ_b	Bond stress (beam test)	MPa ^b
τ_{bu}	Bond stress at maximum force (beam test)	MPa ^b
$\tau_{0.01}, \tau_{0.1}, \tau_1$	Bond stress at 0.01 mm, 0.1 mm and 1 mm slip (beam test)	MPa ^b

^a The unit depends on the property.

^b 1 MPa = 1 N/mm².

5 Designations

The products covered by this standard shall be designated with the following information:

- a) description of the product form (i.e. plain coil, indented coil, ribbed coil, decoiled plain, decoiled indented, decoiled ribbed);
- b) the nominal dimensions of the product;
- c) reference to this standard;
- d) grade (i.e. 500 or 250).

For example, the designation for 8 mm indented wire would be: "Indented coil 8 mm BS 4482".

Where plain coil is specified, the grade shall also be specified. For example, the designation for 8 mm plain wire of grade 250 would be: "Plain coil 8 mm BS 4482 Grade 250".

Where products that conform to this standard are also required to meet all of the requirements of BS EN 10080:2005, for example for the purposes of CE marking, then reference to this standard should also be made in the designation. For example, the designation of the 8 mm indented wire described above would be: "Indented coil BS EN 10080 8 mm BS 4482".

6 Steelmaking and manufacturing processes

The melting process and type of deoxidation of the steel shall be at the discretion of the steel producer.

The manufacturing process for the production of coils shall be at the discretion of the manufacturer. It shall be reported to the purchaser if requested.

Decoiling of coil material shall be done by a machine made for this purpose.

7 Product characteristics

7.1 Chemical composition

The maximum values of individual elements and the carbon equivalent shall not exceed the values given in Table 2.

The carbon equivalent value C_{eq} shall be calculated using the following formula:

$$C_{eq} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

where

Mn is the percentage manganese content;

Cr is the percentage chromium content;

V is the percentage vanadium content;

Mo is the percentage molybdenum content;

Cu is the percentage copper content;

Ni is the percentage nickel content.

Table 2 — Chemical composition (maximum % by mass)

	Carbon	Sulfur	Phosphorus	Nitrogen ^a	Copper	Carbon equivalent
Cast analysis	0.22	0.05	0.05	0.012	0.80	0.42
Product analysis	0.24	0.055	0.055	0.014	0.85	0.44

^a Higher nitrogen contents are permissible if sufficient quantities of nitrogen binding elements are present.