

Stainless steel bars for the reinforcement of and use in concrete — Requirements and test methods

ICS 77.140.15, 91.080.40

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee ISE/9, Steel for concrete reinforcement, to Subcommittee ISE/9/1, Bars, wire and fabric for concrete reinforcement, upon which the following bodies were represented:

- British Cement Association
- British Coatings Federation Ltd.
- British Precast Concrete Federation Ltd.
- Concrete Society
- Department of the Environment, Transport and the Regions — Highways Agency
- Electricity Association
- Institution of Structural Engineers
- UK Certification Authority for Reinforcing Steels
- UK Steel Association

This British Standard, having been prepared under the direction of the Engineering Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 September 2001

© BSI 2009

First published December 1986
Second edition August 2001

The following BSI references relate to the work on this British Standard:
Committee reference ISE/9/1
Draft for comment 00/709560 DC

ISBN 978 0 580 59382 6

Amendments issued since publication

Amd. No.	Date	Comments
15760	3 October 2005	See Table 5
AMD 2	31 March 2009	See foreword

Contents

	Page
Foreword	ii
1 Scope	1
2 Normative references	1
3 Terms, definitions and symbols	1
4 Designation	5
5 Standard sizes	5
6 Dimensions, mass and tolerances	5
7 Steelmaking process	6
8 Chemical composition	6
9 Surface quality	8
10 Surface geometry	8
11 Conditions of supply	9
12 Mechanical and physical properties	9
13 Retests	10
14 Product identification	10
Annex A (normative) Determination of the effective cross-sectional area and mass per metre run of ribbed bars	11
Annex B (informative) Guidance on grade selection to prevent corrosion	12
Annex C (normative) Measurement of the geometrical characteristics	12
Annex D (normative) Inspection and testing	17
Annex E (normative) Bend test	18
Annex F (normative) Method of test for fatigue properties of ribbed bars	18
Annex G (informative) Comparison of similar specifications	19
Annex H (informative) Guidance on magnetic properties	19
Annex I (informative) Third party certification	19
Annex J (informative) Guidance on coefficients of thermal expansion	22
Bibliography	23
Figure 1 — 0.2 % proof test	3
Figure C.1 — Example of bar showing rib geometry	15
Figure C.2 — Rib flank inclination α , and rib height a (Section A.A from Figure C.1)	16
Figure C.3 — Determining the area of the longitudinal section of a rib	16
Table 1 — Symbols	4
Table 2 — Standard sizes	5
Table 3 — Nominal cross-sectional area and nominal mass per metre run	6
Table 4 — Tolerances on mass per metre run	6
Table 5 — Stainless steel bar chemical composition (cast analysis) % by mass	7
Table 6 — Minimum relative rib area, f_R	8
Table 7 — Tensile properties	9
Table B.1 — Guidance on the use of stainless steel reinforcement for different service conditions	12
Table E.1 — Bend test formers	18
Table F.1 — Fatigue test stress ranges	18
Table G.1 — Comparison between the designation systems used in current and former British Standards and American steel specifications	19
Table I.1 — Acceptability index, k , as a function of the number of test results, n , for a reliable failure rate of 5 % (pass = 0.95) at a probability of 90 % ($1 - \alpha = 0.90$)	20
Table J.1 — Comparative thermal coefficient of expansion	22

Foreword

This British Standard has been prepared by Technical Subcommittee, ISE/9/1.

The start and finish of text introduced or altered by Amendment No. 1 and No. 2 is indicated in the text by tags **A1** **A1** and **A2** **A2**.

BS 6744:2001+A2:2009 supersedes BS 6744:2001+A1:2005 which is withdrawn.

NOTE It is anticipated that this standard will be reviewed in 2009.

A2 Attention is drawn to the fact that compliance with this document may involve the use of patents applied to steel grade 1.4162. The patent holder agrees to make the material available for production of stainless steel reinforcing bars on reasonable and accessible and non-discriminatory terms. Information on grade 1.4162 may be obtained from: Outokumpu Stainless Ltd, Europa Link, Sheffield, South Yorkshire S9 1TZ. **A2**

This revision contains new grades and strength levels not in the 1986 revision. Informative annexes have been used to give guidance on grade selection, magnetic properties, coefficients of thermal expansion and third party certification. As far as is possible, the revision has been written to reflect the requirements of BS 4449, *Specification for carbon steel bars for the reinforcement of concrete*.

Annex A, Annex C, Annex D, Annex E and Annex F are normative. Annex B, Annex G, Annex H, Annex I and Annex J are informative.

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 23 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

1 Scope

This British Standard specifies requirements and describes methods of test for solid stainless steel bars used for the reinforcement of, and use in, concrete. It covers plain round steel bars in grade 200 and ribbed and plain steel bars in grades 500 and 650.

This Standard applies to bars in which the ribs have been formed by the cold working or hot rolling processes. This Standard also applies to plain bars.

Stainless steel bars produced from material whose metallurgical history is not known and fully documented are excluded from this standard.

2 Normative references

The following normative documents contain provisions which, through references in this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 8666, *Specification for scheduling, dimensioning, bending and cutting of steel reinforcement for concrete*.

BS EN 10002 (all parts), *Tensile testing of metallic materials*.

BS EN 10021, *General technical delivery requirements for steel and iron products*.

BS EN 10045-1, *Charpy impact test on metallic materials — Part 1: Test method (V- and U-notches)*.

BS EN 10088-1, *Stainless steels — Part 1: List of stainless steels*.

BS EN 10088-3, *Stainless steels — Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes*.

BS EN 10221, *Specification for surface quality classes for hot-rolled bars and rods — Technical delivery conditions*.

BS EN ISO 3651-2, *Determination of resistance to intergranular corrosion of stainless steels — Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in media containing sulfuric acid*.

ISO 10606, *Steel for the reinforcement of concrete — Determination of percentage total elongation at maximum force*.

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this British Standard the terms, definitions and symbols given in BS EN 10088-1 and the following apply.

3.1.1

bar

product of plain round or ribbed cross-section

3.1.2

cold worked ribbed bar

ribbed bar that has been cold worked to meet the property and geometrical requirements of this British Standard

3.1.3

hot rolled ribbed bar

ribbed bar that has been hot worked to meet the property and geometrical requirements of this British Standard

3.1.4

nominal diameter, d

diameter of a circle with an area equal to the effective cross-sectional area of the bar

NOTE See clauses 5 and 6.

3.1.5

coil

continuous as-rolled bar in the form of a coil

3.1.6

length

piece of nominally straight bar cut to a specified length

3.1.7

bundle

two or more coils or a number of lengths properly bound together

3.1.8

batch

any quantity of bars of one size, from one cast and grade, whether in coils or bundles, produced by one manufacturer or supplier, presented for examination at any one time

3.1.9

longitudinal rib

uniform continuous protrusion parallel to the axis of the bar

3.1.10

transverse rib

any rib on the surface of the bar other than a longitudinal rib

3.1.11

rib height, a

distance from the highest point of the rib (transverse or longitudinal) to the surface of the core (see Figure C.2)

3.1.12

rib spacing, c

distance between the centres of two consecutive transverse ribs, measured parallel to the axis of the bar (see Figure C.1)

3.1.13

relative rib area, f_R

area of the projections of all ribs on a plane perpendicular to the longitudinal axis of the wire, or bar, or rod, divided by the wire length and the nominal circumference

3.1.14

transverse rib inclination, β

angle between the axis of the transverse rib and the longitudinal axis of the bar (see Figure C.3)

3.1.15

transverse rib flank inclination, α

angle between the rib flank and the longitudinal axis of the bar (see Figure C.2)

3.1.16

cast (heat) analysis

chemical analysis representative of the cast (heat) determined by the steelmaker at his discretion in a manner of his choice

3.1.17**product analysis**

chemical analysis carried out on a sample of the product

3.1.18**manufacturer**

organization that produces reinforcing steel, including steelmakers, re-rollers and cold workers

3.1.19**supplier**

organization supplying reinforcing steel to an end user

NOTE The product may be supplied in straight lengths or fabricated in accordance with BS 8666.

3.1.20**purchaser**

organization that purchases the product for use in reinforced concrete production

3.1.21**0.2 % proof strength, $R_{p0.2}$**

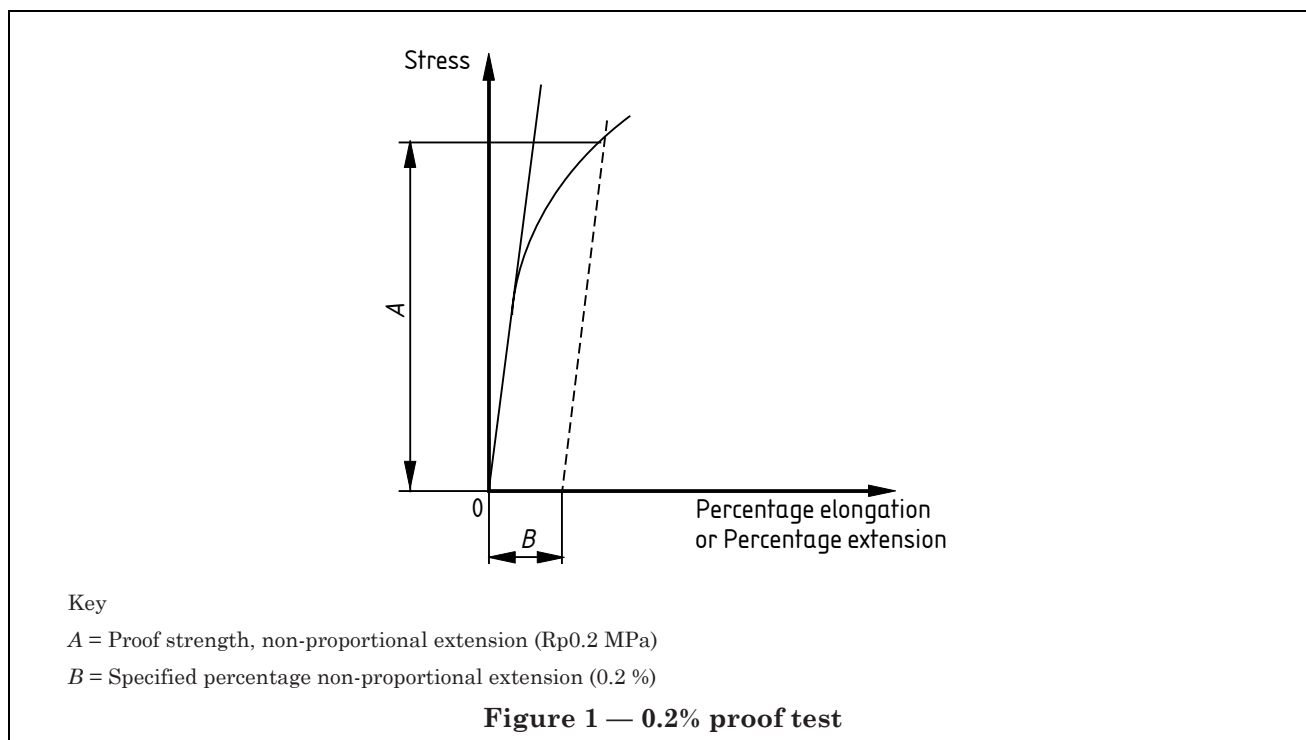
stress at which a non-proportional extension is equal to 0.2 % of the extensometer gauge length (L_e) (see Figure 1)

3.1.22**characteristic strength**

value of the proof stress, having a prescribed probability of not being attained in a hypothetical unlimited test series

the characteristic value is the lower limit of the one-sided statistical tolerance interval at which there is a 90 % probability (i.e. $1-\alpha = 0.90$) 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



3.2 Table of symbols

The symbols used in this British Standard are described in Table 1.

Table 1 — Symbols

Symbol	Unit	Description	Clause(s)
d	mm	Nominal diameter of the bar	3.1.4, 10.3.2, C.3.2, D.1.4, F.2
$R_{p0,2}$	MPa	0,2 % proof strength, non-proportional extension	5.3
R_m	MPa	Tensile strength	12.1, D.1.4, I.2.3, I.2.4
A_5	%	Percentage elongation after fracture	12.1, D.1.4, I.2.3, I.2.4
A_{gt}	%	Percentage total elongation at maximum force	12.1, D.1.4, I.2.3, I.2.4
cv		Characteristic value	3.1.22, I.2.4
M_{mR}	kg/m	Mass per metre run of bar	A.1
M	kg	Mass of bar sample	A.1, A.2
L	m	Length of bar sample	A.1, A.2
ρ	kg/dm ³	Density	A.1, A.2
M'	kg	Mass of bar sample after removal of ribs	A.2
m		Average of a population of results	I.1.2, I.2.4
k		Acceptability index	I.1.2, I.2.4
σ		Standard deviation of a population of results	I.1.2, I.2.4
A	mm ²	Cross-sectional area of the bar	A.1
a	mm	Maximum height of transverse rib	3.1.11, 10.3.2, C.2.1
a'	mm	Height of longitudinal rib	C.2.2, C.3.2
$a_{1/4}$	mm	Rib height at the quarter-point	C.3.3
a_m	mm	Rib height at the mid-point	C.3.3
$a_{3/4}$	mm	Rib height at the three-quarters point	C.3.3
c	mm	Transverse rib spacing	3.1.12, 10.3.2, C.2.3, C.3.2
P	mm	Pitch for cold-twisted bars	C.2.4
Σfi	mm	Part of the circumference without rib	C.2.5
β	°	Angle between the axis of a transverse rib and the bar axis	3.1.14, 10.3.2, C.2.6, C.3.2
α	°	Transverse rib flank inclination	3.1.15, 10.3.2, C.2.7
fR	—	Relative rib area	3.1.13, 10.2, C.3.1, C.3.2, C.3.3, C.3.4
FR	mm ²	Area of the longitudinal section of one rib	C.3.2
n, m, q, p	—	Indices used in calculations of fR and FR	C.3.2
λ	—	Empirical factor in empirical formula for fR	C.3.3

4 Designation

4.1 The steel designation numbers used in this standard shall be defined in accordance with BS EN 10088-1.

4.2 The products covered by this British Standard shall be designated in the following sequence:

- the description of the product form (e.g. plain round or ribbed bar or coil);
- the number of this British Standard (BS 6744:2001);
- the nominal dimensions of the product (see clause 5 and 6.2);
- the BS EN 10088-1 steel designation number (see $\square A_2$ Table 5 $\square A_2$);
- the strength grade (see Table 6).

EXAMPLE

In accordance with this British Standard, a ribbed bar with a nominal diameter of 20 mm, a nominal length of 12 000 mm, steel designation number 1.4301, and strength grade 500:

Ribbed bar BS 6744:2001-20×12000-1.4301, 500.

5 Standard sizes

The range of sizes of bars in all grades shall be from 3 mm to 50 mm.

NOTE 1 The range of standard sizes is given in Table 2.

Table 2 — Standard sizes

Grade	Nominal sizes mm
200 ^a	3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 20, 25, 30, 35, 40, 50
500	3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 20, 25, 32, 40, 50
650	3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 20, 25 $\square A_2$, 32, 40, 50 $\square A_2$
^a Plain only	

NOTE 2 Other sizes may be made available on request.

6 Dimensions, mass and tolerances

6.1 Effective cross-sectional area and mass per metre run

The effective cross-sectional area and mass per metre run of the bars shall be calculated using the method described in Annex A.

The values for the nominal cross-sectional area and nominal mass per metre run of individual bars shall be as given in Table 3.

The tolerances on mass per metre run shall be in accordance with Table 4.

NOTE The values for the nominal mass per metre run are calculated from the values of the nominal cross-sectional area using density values in BS EN 10088-1.