

Specification for

Carbon steel bars for the reinforcement of concrete

ICS 77.140.15; 91.080.40

Committees responsible for this British Standard

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- British Cement Association
- British Coatings Federation
- British Iron and Steel Producers' Association
- British Precast Concrete Federation
- Concrete Society
- Dept. of Environment – Building Research Establishment
- Dept. of Transport – Highways Agency
- Electricity Association
- Institution of Structural Engineers
- UK Certification Authority for Reinforcing Steels

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Foreword

This British Standard has been prepared by Technical Committee ISE/9/1, and is a revision of BS 4449:1988, which is withdrawn.

This edition introduces technical changes but it does not reflect a full review or revision of the standard, which will be undertaken in due course. This edition contains some of the requirements that are contained in DD ENV 10080, and aims to prepare the UK market for the eventual publication of EN 10080.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 18, an inside back cover and a back cover.

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1 Scope

This British Standard specifies requirements for weldable steel bars for reinforcement of concrete. It covers plain round steel bars in grade 250, and deformed (type 1 and type 2) high yield steel bars in grade 460, the latter in two ductility categories, 460A and 460B.

The weldability requirements for both grades of steel are specified in terms of the carbon equivalent value. A testing facility for material covered by a third party product certification scheme, and a testing facility for material not covered by such a scheme, are provided.

Steel bars for use as lifting hooks are not included in this British Standard.

Steel bars produced by re-rolling finished products, or by rolling material of which the metallurgical history is not fully documented or not known, are not covered by this British Standard.

NOTE 1 Flash welds in lengths of bar are permissible. However, for some purposes, purchasers may specifically require bars without flash welds. For this reason, the manufacturer should enquire whether flash welds are acceptable for the purposes of the purchaser at the time of enquiry and/or order (see Annex A).

NOTE 2 All steels conforming to this British Standard are of weldable quality. Appropriate welding procedures and consumables, to each particular grade and quality, should be used (see BS 7123).

2 References

2.1 Normative references

This British Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this British Standard only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This British Standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

3 Definitions

For the purposes of this British Standard the following definitions apply.

3.1

bar

a steel product of plain round or deformed cross section

3.2

hot rolled deformed bar

a bar that has been so shaped during hot rolling that it conforms to either the geometrical or the performance test classification given in clause 9

3.3

cold worked deformed bar

a bar that has been cold worked to conform to the property requirements of this British Standard and that conforms to either the geometrical or the performance test classification given in clause 9

3.4

nominal size

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

NOTE See clause 4 and Annex B.

3.5

coil

a continuous as-rolled bar in the form of a coil

3.6**length**

a piece of nominally straight bar cut to a specified length

3.7**bundle**

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

3.8**batch**

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

3.9**longitudinal rib**

a uniform continuous protrusion parallel to the axis of the bar, before twisting in the case of cold twisted bars

3.10**transverse rib**

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

3.11**flash weld**

resistance butt weld, in which the components are progressively advanced towards each other, while the electric current, confined to localized points of contact, causes molten metal to be expelled. When welding temperature is reached, upset force is applied

3.12**manufacturer**

an organization that produces reinforcing steel. This includes steelmakers, re-rollers and cold workers

3.13**supplier**

any organization supplying reinforcing steel to an end user

NOTE Reinforcing steel may be supplied in lengths or coil, or fabricated in accordance with BS 4466.

3.14**characteristic strength**

the value of yield strength 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

4 Sizes**4.1 Range**

The range of nominal sizes of bars in grades 250 and 460 shall be from 6 mm to 50 mm.

NOTE The preferred nominal sizes of bars are given in Table 1.

Table 1 — Preferred nominal sizes

Grade	Nominal size mm
250	8, 10, 12, 16
460	8, 10, 12, 16, 20, 25, 32, 40
NOTE 1 If a bar smaller than 8 mm is required, the recommended size is 6 mm.	
NOTE 2 If a bar larger than 40 mm is required, the recommended size is 50 mm.	

4.2 Tolerance

The deviation of any cross sectional dimension from its nominal size (other than those of ribs), shall not exceed 8 %.

5 Cross sectional area and mass

The cross sectional area and mass of the bars shall be calculated on the basis that steels have a mass of 0.00785 kg per square millimetre per metre run.

The values for the nominal cross sectional area shall be as given in Table 2. The mass of individual bars shall be as given in Table 2, subject to the tolerances given in Table 3.

For bars where the effective cross sectional area is determined as in **B.2.2**, the nominal mass per metre run shall equate to the gross mass per metre run.

The total cross sectional area and total mass of two or more bars shall be calculated pro rata on the basis of the values for an individual bar. All cross sectional areas derived from the values in Table 2 shall be expressed to three significant figures.

Table 2 — Cross sectional area and mass

Nominal size mm	Cross sectional area mm ²	Mass per metre run kg
6 ^a	28.3	0.222
8	50.3	0.395
10	78.5	0.616
12	113.1	0.888
16	201.1	1.579
20	314.2	2.466
25	490.9	3.854
32	804.2	6.313
40	1256.6	9.864
50 ^a	1963.5	15.413

^a This is a non-preferred size.

Table 3 — Tolerance on mass

Nominal size mm	Tolerance on mass per metre run %
6	±9
8 and 10	±6.5
12 and over	±4.5

6 Length

The permissible deviation from the nominal length shall be $^{+100}_0$ mm. Other tolerances may be agreed at the time of enquiry and order.

7 Steelmaking process

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

8 Chemical composition

8.1 Cast analysis

The chemical composition of the steel, based on cast analysis, shall be in accordance with Table 4.

Bars of both grades shall have a carbon equivalent value, based on cast analysis, not exceeding the maximum values given in Table 5.

The following formula shall be used to calculate the carbon equivalent value, where the chemical symbols represent the percentages of each element:

$$\text{carbon equivalent value} = C + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Ni} + \text{Cu}}{15}$$

In cases of dispute, the appropriate methods of test given in BS 6200-3 shall be used.

Table 4 — Chemical composition of steel grades: cast analysis

Element	Grade 250 % (max.)	Grade 460 % (max.)
Carbon	0.25	0.25
Sulfur	0.060	0.050
Phosphorus	0.060	0.050
Nitrogen	0.012	0.012
NOTE 1 The maximum value for nitrogen does not apply if the chemical composition shows a minimum aluminium content of 0.020 %, or if sufficient other nitrogen binding elements are present.		
NOTE 2 Nitrogen content is not normally given on a release certificate.		

Table 5 — Maximum carbon equivalent values: cast analysis

Grade	Maximum carbon equivalent value %
250	0.42
460	0.51

8.2 Product analysis and permitted deviations

8.2.1 The maximum deviations on product analysis from the values specified for cast analysis (see Table 4 and Table 5) shall be as given in Table 6.

NOTE The product analysis may vary from the cast analysis due to chemical heterogeneity arising during the casting and solidification processes.

Table 6 — Maximum deviations in chemical composition on product analysis

Element	Deviation above the specified maximum given in Table 4 and Table 5 %
Carbon	0.02
Sulfur	0.005
Phosphorus	0.005
Total nitrogen	0.001
Carbon equivalent value	0.03

8.2.2 Samples for product analysis shall be taken in accordance with the appropriate method of BS 6200-3.

8.2.3 During product analysis, any bar that falls outside the maximum deviation limits for the composition range of a specified element, given in Table 6, shall be deemed not to conform to this British Standard.