

Specification for

Metallic resistance materials for electrical purposes

UDC 621.316.84

Confirmed January 2011

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Cables and Insulation Standards Policy Committee (CIL/-) to Technical Committee CIL/55, upon which the following bodies were represented:

- Covered Conductors Association
- Electrical and Electronic Insulation Association (BEAMA Ltd.)
- Transmission and Distribution Association (BEAMA Ltd.)

This British Standard, having been prepared under the direction of the Cables and Insulation Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 March 1995

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First published September 1921
Second edition September 1924
Third edition January 1938
Fourth edition April 1954
Fifth edition March 1995

The following BSI references relate to the work on this standard:
Committee reference CIL/55
Draft for comment 93/213613 DC

ISBN 0 580 22961 0

Amendments issued since publication

Amd. No.	Date	Comments
8751	March 1995	Indicated by a sideline in the margin

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Foreword

This British Standard has been prepared under the direction of the Cables and Insulation Standards Policy Committee. It is a revision of BS 115:1954 which is withdrawn.

Unlike the previous edition, in this standard metallic resistance materials are divided into four classes with no reference to the maximum working temperature of the materials. The inclusion of maximum working temperatures was considered to be too subjective, as the question of devising a suitable life test to prove these has been impractical, because of the numerous factors which affect high-temperature performance. Classification is therefore effected by typical values of temperature coefficient of resistance and resistivity. The materials are coded for class, alloy, condition and grade.

New tolerances have been introduced for resistance and uniformity of resistance of wire (including a new grade), out-of-roundness, straightness, the width of strip and tape, and the width and thickness of sheet.

New sections have been included on temperature coefficient of resistance, spiralling test, product marking, documentation, packaging and health and safety.

The section on physical and mechanical properties has been modified.

Formulae for the calculation of resistance per unit length of wire, strip and tape together with density/mass formulae for determining the cross-section of small dimensional material are given.

It has not been possible to specify definitive requirements for wire and strip supplied in cut and straightened lengths as the cutting and straightening processes can cause variations in electrical properties. Recommendations on dimensional tolerances have, however, been included.

Product certification. Users of this British Standard are advised to consider the desirability of third party certification of product conformity with this British Standard based on testing and continuing product surveillance which may be coupled with assessment of a supplier's quality systems against the appropriate Standard in the BS EN ISO 9000 series.

Enquiries as to the availability of third party certification schemes are forwarded by BSI to the Association of British Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching an appropriate body from the list of Association members.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 20, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Introduction

Maximum working temperatures are not definitive for an alloy. They are affected by the following:

- a) alloy type;
- b) temperature;
- c) diameter or thickness;
- d) temperature cycling;
- e) whether the elements are open to the atmosphere or surrounded by refractory, as in mineral filled elements;
- f) the general conditions of use.

For these reasons, classifying materials by maximum operating temperatures was not considered to be satisfactory. It was preferable to classify these materials by temperature coefficient of resistance and resistivity, subdividing these classes into alloys which could be coded by reference to typical composition.

Due to order-disorder reactions, the resistivity and temperature coefficient of resistance of some of the materials in this standard are affected by the rate at which they are cooled from the annealing temperature. These values can also be altered by the amount of cold work, so that materials supplied in the tempered condition may be affected.

Section 1. General

1.1 Scope

This British Standard specifies requirements for the dimensions, electrical and mechanical properties of metallic resistance materials in the form of wire, strip, tape and sheet.

It also provides a classification of these materials based on the typical temperature coefficient of resistance and resistivity, then subdivided into alloys. Codes are assigned to each known alloy within the class. Other alloys, not specifically listed, may also be classified and coded. A grading of materials, based on tolerances on resistance, is also introduced.

Requirements for product marking, documentation and packaging are also specified.

In addition to the definitive requirements, this standard also requires the items detailed in 1.4 to be documented. For compliance with this standard, both the definitive requirements and the documented items have to be satisfied.

Material conditions, limits of uncertainty, details of the sizes of wire in general use and conversion factors to foot-pound units are given in Annex A to Annex D and recommendations are also made relating to health and safety (Annex E).

This standard does not specify requirements for wire and strip supplied in cut and straightened lengths but recommendations on tolerances are given in Annex F.

NOTE 1 For nickel and nickel alloys supplied in cut and straightened lengths for structural use see BS 3073 and BS 3075.

NOTE 2 For fine resistance wires for special purposes, e.g. telecommunication, reference should be made to BS 1117.

1.2 References

1.2.1 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.

1.2.2 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.

1.3 Definitions

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

1.3.1

typical

the average value derived from published data by all suppliers

1.3.2

nominal

the average value declared by the supplier

1.3.3

actual

the measured value

1.3.4

nominal resistance

the resistance calculated from the nominal dimensions and nominal resistivity for the condition of the material declared by the supplier (see 3.2)

1.3.5

strip

cold rolled material, slit with square edges, in widths over 3 mm up to 152 mm

1.3.6

tape

strip with rounded edges normally in the size ranges of width, 0.3 mm to 6.35 mm and thickness 0.05 mm to 2.0 mm

NOTE Reference should be made to the suppliers' data to ascertain the combinations of width and thickness which are available.

1.3.7

round edged strip

strip with rolled or ground round edges

1.3.8

sheet

material in widths from 152 mm to 610 mm

1.3.9

concession

a deviation in the physical, mechanical or dimensional properties of the metallic resistance material from that specified, that has been accepted by the purchaser

1.4 Information and requirements to be agreed and to be documented

1.4.1 Information to be supplied by the purchaser

The following information to be supplied by the purchaser shall be fully documented. Both the definitive requirements specified throughout this British Standard and the following documented items shall be satisfied before a claim of compliance with the standard can be made and verified.

- a) The supply condition required if other than that specified in **6.1** (see also **2.2**).
- b) The alloy, class and grade required.
- c) The tolerance on nominal resistance if other than that given in Table 6 or Table 7 (see **3.3**).

1.4.2 Items to be agreed

The following items to be agreed between the contracting parties, which are specified in the clauses referred to, shall be fully documented. Both the definitive requirements specified in this British Standard and the following documented items shall be satisfied before a claim of compliance with the standard can be made and verified.

- a) The form of declaration of the properties listed in **1.4.3** if other than as published literature.
- b) If the temperature coefficient of resistance in the range 20 °C to 200 °C is to be determined (see **4.3.2**) on material in the as-despatched condition for classes C and D.
- c) If the values of any of the additional physical properties listed in **6.7** are to be determined.
- d) Any additional information to be included in the certificate of conformity (see **7.2**).

1.4.3 Information to be declared by the supplier

The following information to be declared by the supplier shall be fully documented.

- a) The nominal resistivity (in $\mu\Omega\cdot\text{cm}$) at 20 °C for the material in the condition as supplied (see **3.1** and **3.2**).
- b) The calculated nominal resistance per unit length of tape, wire, strip and round-edged strip at 20 °C and, where applicable, the reduction factor used in the calculation of cross-sectional area (see **3.2**).
- c) The nominal temperature coefficient of resistance (see **4.1**).
- d) For materials in classes A and B only, the nominal thermoelectromotive force (in mV/K) between 0 °C and 100 °C and the polarity of the material against copper (see **6.2**).
- e) When agreed [see **1.4.2 c**], the nominal values of the applicable physical properties listed in **6.7**.

NOTE These nominal values may be documented in published literature or another form agreed between purchaser and supplier [see **1.4.2 a**].