
Superprevodnost - 4. del: Meritve razmerja preostale upornosti - Preostala upornost za superprevodnike iz kompozita Nb-Ti

Superconductivity - Part 4: Residual resistance ratio measurement - Residual resistance ratio of Nb-Ti composite superconductors

Supraleitfähigkeit - Teil 4: Messungen des Restwiderstandsverhältnisses - Restwiderstandsverhältnis von Nb-Ti-Verbundsupraleitern

Supraconductivité - Partie 4: Mesure de la résistivité résiduelle - Taux de résistivité résiduelle des supraconducteurs composites au Nb-Ti

<https://standards.iteh.ai/catalog/standards/sist/4b134122-e58a-4485-a39c-140cdf26b24/sist-en-61788-4-2011>

Ta slovenski standard je istoveten z: EN 61788-4:2011

ICS:

17.220.20	Merjenje električnih in magnetnih veličin	Measurement of electrical and magnetic quantities
29.050	Superprevodnost in prevodni materiali	Superconductivity and conducting materials

SIST EN 61788-4:2011**en**

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 61788-4:2011

<https://standards.iteh.ai/catalog/standards/sist/4b134122-e58a-4485-a39c-140cdaf26b24/sist-en-61788-4-2011>

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 61788-4

August 2011

ICS 17.220.20; 29.050

Supersedes EN 61788-4:2007

English version

**Superconductivity -
Part 4: Residual resistance ratio measurement -
Residual resistance ratio of Nb-Ti composite superconductors
(IEC 61788-4:2011)**

Supraconductivité -
Partie 4: Mesure du rapport de résistance
résiduelle -
Rapport de résistance résiduelle des
supraconducteurs composites de Nb-Ti
(CEI 61788-4:2011)

Supraleitfähigkeit -
Teil 4: Messung des
Restwiderstandsverhältnisses -
Restwiderstandsverhältnis von Nb-Ti
Verbundsupraleitern
(IEC 61788-4:2011)

iTeh STANDARD PREVIEW
(standards.iteh.ai)

This European Standard was approved by CENELEC on 2011-08-15. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 90/263/FDIS, future edition 3 of IEC 61788-4, prepared by IEC TC 90, Superconductivity was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61788-4:2011.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2012-05-15
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2014-08-15

This document supersedes EN 61788-4:2007.

The main revisions are the addition of two new annexes, "Uncertainty considerations" (Annex B) and "Uncertainty evaluation in test method of RRR for NbTi" (Annex C).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
Endorsement notice

The text of the International Standard IEC 61788-4:2011 was approved by CENELEC as a European Standard without any modification.

<https://standards.iteh.ai/catalog/standards/sist/4b134122-e58a-4485-a39c-140cdaf26b24/sist-en-61788-4-2011>

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-815	-	International Electrotechnical Vocabulary - Part 815: Superconductivity	-	-

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN 61788-4:2011](https://standards.iteh.ai/catalog/standards/sist/4b134122-e58a-4485-a39c-140cdaf26b24/sist-en-61788-4-2011)

<https://standards.iteh.ai/catalog/standards/sist/4b134122-e58a-4485-a39c-140cdaf26b24/sist-en-61788-4-2011>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 61788-4:2011

<https://standards.iteh.ai/catalog/standards/sist/4b134122-e58a-4485-a39c-140cdaf26b24/sist-en-61788-4-2011>



IEC 61788-4

Edition 3.0 2011-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Superconductivity – **STANDARD PREVIEW**
Part 4: Residual resistance ratio measurement – Residual resistance ratio of
Nb-Ti composite superconductors

Supraconductivité –
Partie 4: Mesure du rapport de résistance résiduelle – Rapport de résistance
résiduelle des supraconducteurs composites de Nb-Ti

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

U

ICS 17.220.20; 29.050

ISBN 978-2-88912-554-8

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions.....	7
4 Requirements.....	8
5 Apparatus.....	8
5.1 Material of measuring mandrel or of measuring base plate.....	8
5.2 Diameter of the measuring mandrel and length of the measuring base plate.....	8
5.3 Cryostat for the resistance, R_2 , measurement.....	9
6 Specimen preparation.....	9
7 Data acquisition and analysis.....	9
7.1 Resistance (R_1) at room temperature.....	9
7.2 Resistance (R_2^*) just above the superconducting transition.....	9
7.3 Correction on measured R_2^* for bending strain.....	11
7.4 Residual resistance ratio (RRR).....	12
8 Uncertainty and stability of the test method.....	12
8.1 Temperature.....	12
8.2 Voltage measurement.....	12
8.3 Current.....	12
8.4 Dimension.....	12
9 Test report.....	13
9.1 RRR value.....	13
9.2 Specimen.....	13
9.3 Test conditions.....	13
Annex A (informative) Additional information relating to the measurement of RRR	15
Annex B (informative) Uncertainty considerations.....	21
Annex C (informative) Uncertainty evaluation in test method of RRR for Nb-Ti.....	25
Figure 1 – Relationship between temperature and resistance. Temperature T_c^* is that at the intersection point.....	8
Figure 2 – Voltage (U) versus temperature (T) curves and definitions of each voltage.....	10
Figure A.1 – Definition of voltages.....	16
Figure A.2 – Bending strain dependency of RRR for pure Cu matrix of Nb-Ti composite superconductors (comparison between measured values and calculated values).....	18
Figure A.3 – Bending strain dependency of RRR for round Cu wires.....	18
Figure A.4 – Bending strain dependency of normalized RRR for round Cu wires.....	19
Figure A.5 – Bending strain dependency of RRR for rectangular Cu wires.....	19
Figure A.6 – Bending strain dependency of normalized RRR for rectangular Cu wires.....	20
Figure C.1 – Distribution of observed RRR of Cu/Nb-Ti composite superconductor.....	28
Table B.1 – Output signals from two nominally identical extensometers.....	22
Table B.2 – Mean values of two output signals.....	22

Table B.3 – Experimental standard deviations of two output signals.....	22
Table B.4 – Standard uncertainties of two output signals	22
Table B.5 – Coefficient of variations of two output signals.....	23
Table C.1 – Uncertainty of each measurement.....	27

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 61788-4:2011

<https://standards.iteh.ai/catalog/standards/sist/4b134122-e58a-4485-a39c-140cdaf26b24/sist-en-61788-4-2011>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SUPERCONDUCTIVITY –

**Part 4: Residual resistance ratio measurement –
Residual resistance ratio of Nb-Ti composite superconductors**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61788-4 has been prepared by IEC technical committee 90: Superconductivity.

This third edition cancels and replaces the second edition published in 2007. It constitutes a technical revision. The main revisions are the addition of two new annexes, "Uncertainty considerations" (Annex B) and "Uncertainty evaluation in test method of RRR for NbTi" (Annex C).

The text of this standard is based on the following documents:

FDIS	Report on voting
90/263/FDIS	90/275/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61788 series, published under the general title *Superconductivity*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

iTeh STANDARD PREVIEW

(standards.iteh.ai)

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

<https://standards.iteh.ai/catalog/standards/sist/4b134122-e58a-4485-a39c-140cdf26b24/sist-en-61788-4-2011>

INTRODUCTION

Copper is used as a matrix material in multifilamentary superconductors and works as an electrical shunt when the superconductivity is interrupted. It also contributes to recovery of the superconductivity by conducting heat generated in the superconductor to the surrounding coolant. The cryogenic-temperature resistivity of copper is an important quantity, which influences the stability of the superconductor. The residual resistance ratio is defined as a ratio of the resistance of the superconductor at room temperature to that just above the superconducting transition.

In this International Standard, the test method of residual resistance ratio of Nb-Ti composite superconductors is described. The curve method is employed for the measurement of the resistance just above the superconducting transition. Other methods are described in Clause A.3.

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

[SIST EN 61788-4:2011](https://standards.iteh.ai/catalog/standards/sist/4b134122-e58a-4485-a39c-140cdaf26b24/sist-en-61788-4-2011)

<https://standards.iteh.ai/catalog/standards/sist/4b134122-e58a-4485-a39c-140cdaf26b24/sist-en-61788-4-2011>