
Superconductivity - Part 11: Residual resistance ratio measurement - Residual
resistance ratio of Nb₃Sn composite superconductors

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EUROPEAN STANDARD

EN 61788-11

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April 2003

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Superconductivity
Part 11: Residual resistance ratio measurement -
Residual resistance ratio of Nb₃Sn composite superconductors
(IEC 61788-11:2003)

Supraconductivité
Partie 11: Mesure du rapport
de résistance résiduelle -
Rapport de résistance résiduelle
des supraconducteurs composites
de Nb₃Sn
(CEI 61788-11:2003)

Supraleitfähigkeit
Teil 11: Messung des
Restwiderstandsverhältnisses -
Restwiderstandsverhältnis von
Nb₃Sn-Verbundsupraleitern
(IEC 61788-11:2003)

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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, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 90/131/FDIS, future edition 1 of IEC 61788-11, prepared by IEC TC 90, Superconductivity, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61788-11 on 2003-03-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2003-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2006-03-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annex A is informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61788-11:2003 was approved by CENELEC as a European Standard without any modification.

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Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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	- ¹⁾	International Electrotechnical Vocabulary (IEV) Chapter 815: Superconductivity	-	-

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¹⁾ Undated reference.

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NORME
INTERNATIONALE
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61788-11

Première édition
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2003-01

Supraconductivité –

Partie 11:

**Mesure du rapport de résistance résiduelle –
Rapport de résistance résiduelle des
supraconducteurs composites de Nb₃Sn**

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Superconductivity –

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Part 11:

**Residual resistance ratio measurement –
Residual resistance ratio of Nb₃Sn composite
superconductors**

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

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CONTENTS

FOREWORD	5
INTRODUCTION	7
1 Scope	9
2 Normative references.....	9
3 Terms and definitions	9
4 Requirements	11
5 Apparatus	11
5.1 Material of measuring base plate	11
5.2 Length of the measuring base plate	11
5.3 Cryostat for the resistance R_2 measurement.....	11
6 Specimen preparation.....	11
7 Data acquisition	11
7.1 Resistance (R_1) at room temperature.....	11
7.2 Resistance (R_2) just above the superconducting transition.....	13
7.3 Residual resistance ratio (RRR).....	15
8 Accuracy and stability in the test method	17
8.1 Temperature	17
8.2 Voltage measurement.....	17
8.3 Current	17
9 Test report.....	17
9.1 Specimen	17
9.2 Report of RRR values	17
9.3 Report of test conditions	17
Annex A (informative) Additional information relating to measurement of RRR	23
Figure 1 – Relationship between temperature and voltage	21
Figure 2 – Voltage versus temperature curves and definition of each voltage	21

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SUPERCONDUCTIVITY –

**Part 11: Residual resistance ratio measurement –
Residual resistance ratio of Nb₃Sn composite superconductors**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
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- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61788-11 has been prepared by IEC Technical Committee 90: Superconductivity.

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

FDIS	Report on voting
90/131/FDIS	90/134/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.

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

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

INTRODUCTION

Copper or aluminium is used as stabilizer material in multifilamentary Nb₃Sn superconductors and works as an electrical shunt when the superconductivity is interrupted. It also contributes to recovery of the superconductivity by conducting the heat generated in the superconductor to the surrounding coolant. The resistivity of copper used in the composite superconductor in the cryogenic temperature region 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 for the residual resistance ratio of Nb₃Sn 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.2.

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SUPERCONDUCTIVITY –

Part 11: Residual resistance ratio measurement – Residual resistance ratio of Nb₃Sn composite superconductors

1 Scope

This part of IEC 61788 covers a test method for the determination of the residual resistance ratio (*RRR*) of Nb₃Sn composite conductors. This method is intended for use with superconductor specimens that have a monolithic structure with a rectangular or round cross section, *RRR* less than 350 and cross-sectional area less than 3 mm², and have received a reaction heat-treatment. Ideally, it is intended that the specimens are as straight as possible; however, this is not always the case, thus care must be taken to measure the specimen in its as received condition. All measurements are done without an applied magnetic field.

The method described in the body of this standard is the “reference” method; optional acquisition methods are outlined in Annex A.

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.

IEC 60050-815, *International Electrotechnical Vocabulary (IEV) – Part 815: Superconductivity*
SIST EN 61788-11:2003
<https://standards.iteh.org/standards/sist/61788-11/iec-60050-815-4104-257-eee7fe4a47c9/sist-en-61788-11-2003>

3 Terms and definitions

For the purposes of this part of IEC 61788, the terms and definitions given in IEC 60050-815 and the following apply.

3.1

residual resistance ratio

RRR (abbreviation)

the ratio of resistance at room temperature to the resistance just above the superconducting transition

The residual resistance ratio of the composite wire is obtained in equation (1) below, where the resistance (R_1) at room temperature (20 °C) is divided by the resistance (R_2) just above the superconducting transition.

$$RRR = \frac{R_1}{R_2} \quad (1)$$

Figure 1 shows schematically a voltage versus temperature curve acquired on a specimen while measuring cryogenic resistance. Draw a line in Figure 1 where the voltage sharply increases (a), and draw also a line in Figure 1 where the voltage increases gradually (b) with temperature. The value of resistance at the intersection of these two lines, A, is defined as resistance (R_2) just above the superconducting transition.