BS EN 61788-5:2013

BSI Standards Publication

Superconductivity

Part 5: Matrix to superconductor volume ratio measurement — Copper to superconductor volume ratio of Cu/Nb-Ti composite superconducting wires

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National foreword

This British Standard is the UK implementation of EN 61788-5:2013. It is identical to IEC 61788-5:2013. It supersedes BS EN 61788-5:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee L/-/90, Super Conductivity.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English version

Superconductivity - Part 5: Matrix to superconductor volume ratio measurement - Copper to superconductor volume ratio of Cu/Nb-Ti composite superconducting wires

(IEC 61788-5:2013)

Supraconductivité -
Partie 5 : Mesure du rapport volumique matrice/supraconducteur -
Rapport volumique cuivre/supraconducteur des fils en composite supraconducteur Cu/Nb-Ti
(CEI 61788-5:2013)

Supraleitfähigkeit -
Teil 5: Messung des Verhältnisses von Matrixvolumen zu Supraleitervolumen -
Verhältnis von Kupfervolumen zu Supraleitervolumen von Cu/Nb-Ti Verbundsupraleiterdrähten
(IEC 61788-5:2013)

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Foreword

The text of document 90/321/FDIS, future edition 2 of IEC 61788-5, prepared by IEC/TC 90 "Superconductivity" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61788-5:2013.

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)	2014-04-02
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2016-07-02

This document supersedes EN 61788-5:2001.

EN 61788-5:2013 includes the following significant technical changes with respect to EN 61788-5:2001:

The main revisions are the addition of two new annexes, "Uncertainty considerations" (Annex E) and "Uncertainty evaluation in test method of copper to superconductor volume ratio of Cu/Nb-Ti composite superconductors" (Annex F).

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.

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The text of the International Standard IEC 61788-5:2013 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

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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.

Publication	Year	Title	EN/HD	Year
IEC 60050-815	Series	International Electrotechnical Vocabulary (IEV)	-	-

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Full document details: BS EN 61788-5:2013

CONTENTS

INTRODUCTION 5
1 Scope 6
2 Normative references 6
3 Terms and definitions 6
4 Principle 7
5 Chemicals 7
6 Apparatus 7
7 Measurement procedure 8
7.1 Quantity of specimen 8
7.2 Removal of insulating cover material 8
7.3 Cleaning 8
7.4 Drying 8
7.5 Measurement of specimen mass and its repetition 8
7.6 Dissolving copper 8
7.7 Cleaning and drying the Nb-Ti filaments 9
7.8 Measurement of dissolved specimen mass and its repetition 9
7.9 Procedural repetition for second specimen 10
8 Calculation of results 10
9 Uncertainty of the test method 10
10 Test report 11
10.1 Identification of test specimen 11
10.2 Report of copper to superconductor volume ratio 11
10.3 Report of test conditions 11
Annex A (normative) Copper to superconductor volume ratio – copper mass method 12
Annex B (informative) Specific mass depending on Nb-Ti fraction 14
Annex C (information) Mechanical removal of insulating cover materials 15
Annex D (informative) Second etch of specimen 16
Annex E (informative) Uncertainty considerations 17
Annex F (informative) Uncertainty evaluation in the test method of copper to superconductor volume ratio of Cu/Nb-Ti composite superconductors 22

Table B.1 – Specific mass of Nb-Ti 14
Table E.1 – Output signals from two nominally identical extensometers 18
Table E.2 – Mean values of two output signals 18
Table E.3 – Experimental standard deviations of two output signals 18
Table E.4 – Standard uncertainties of two output signals 19
Table E.5 – Coefficient of variations of two output signals 19

Documents
Document Sharing Hub
Full document details: BS EN 61788-5:2013

INTRODUCTION

The copper to superconductor volume ratio of composite superconductors is used mainly to calculate the critical current density of superconducting wires. The test with the method given in this International Standard may be used to provide part of the information needed to determine the suitability of a specific superconductor. Moreover, this method is useful for quality control, acceptance or research testing if the precautions given in this standard are observed.

The test method given in this International Standard is based on the condition that the specific mass of Nb-Ti is known or the Nb-Ti alloy fraction is known and Annex B can be used to estimate the specific mass. If the specific mass of Nb-Ti is unknown and the Nb-Ti alloy fraction is unknown and/or the fraction of Nb barrier is unknown, another method to determine the copper to superconductor volume ratio of composite superconductors is described in Annex A.

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SUPERCONDUCTIVITY –

Part 5: Matrix to superconductor volume ratio measurement – Copper to superconductor volume ratio of Cu/Nb-Ti composite superconducting wires

1 Scope

This part of IEC 61788 covers a test method for the determination of copper to superconductor volume ratio of Cu/Nb-Ti composite superconducting wires.

This test method and the alternate method in Annex A are intended for use with Cu/Nb-Ti composite superconducting wires with a cross-sectional area of 0,1 mm^2 to 3 mm^2, a diameter of the Nb-Ti filament(s) of 2 μm to 200 μm, and a copper to superconductor volume ratio of 0,5 or more.

The Cu/Nb-Ti composite test conductor discussed in this method has a monolithic structure with a round or rectangular cross-section. This test method is carried out by dissolving the copper with nitric acid. Deviations from this test method that are allowed for routine tests and other specific restrictions are given in this standard.

Cu/Nb-Ti composite superconducting wires beyond the limits in the cross-sectional area, the filament diameter and the copper to superconductor volume ratio could be measured with this present method with an anticipated reduction of uncertainty. Other, more specialized, specimen test geometries may be more appropriate for conductors beyond the limits and have been omitted from this present standard for simplicity and to retain low uncertainty.

The test method given in this standard is expected to apply to other superconducting composite wires after some appropriate modifications.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org>)

3 Terms and definitions

For the purposes of this document, the definitions given in IEC 60050-815 as well as the following definition apply.

3.1
copper to superconductor volume ratio
ratio of the volume of the copper stabilizing material to the volume without copper consisting of Nb-Ti filaments and their Nb barriers

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4 Principle

The test method utilizes the nature of the Cu/Nb-Ti composite superconducting wire whereby the copper dissolves in nitric acid solution but the Nb-Ti filaments and Nb barriers do not.

After measuring its mass, dip the specimen into the nitric acid solution to dissolve only the copper.

Then measure the mass of the remaining Nb-Ti filaments and their Nb barriers.

The volume and mass of the starting wire and the mass of the filaments are used to determine the copper to superconductor volume ratio.

5 Chemicals

The following chemicals shall be prepared for sample preparation:

a) nitric acid solution consisting of nitric acid (a volume fraction of 50 % to 65 % recommended) and distilled water;
b) organic solvent;
c) degreasing solvent;
d) ethyl alcohol;
e) distilled (pure) water.

NOTE When nitric acid of more than a mass fraction of 65 % is used, the acid is diluted with distilled water within the range of the above content.

6 Apparatus

The following apparatus shall be prepared.

- Draft chamber
- Balance

A balance shall have a manufacturer's specified uncertainty of ±0,1 mg or better.

- Dryer or drying oven

A dryer or a drying oven shall be used for evaporating moisture after washing the specimen.

- Beaker
- Watch-glass
- Plastic tweezers
- Filter papers
- Thermometer
- Rubber gloves and protection spectacles

Rubber gloves and protection spectacles shall be used for protecting the human body from the harmful acid liquid or fumes. The dissolution of the specimen shall be performed in a draft chamber in order to protect the human body.

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