SLOVENSKI STANDARD
SIST EN IEC 61788-7:2020

01-julij-2020

Nadomešča:

SIST EN 61788-7:2007

Superprevodnost - 7. del: Meritve elektronskih lastnosti - Površinska upornost visokotemperaturnih superprevodnikov pri mikrovalovnih frekvencah (IEC 61788-7:2020)

Superconductivity - Part 7: Electronic characteristic measurements - Surface resistance of high-temperature superconductors at microwave frequencies (IEC 61788-7:2020)

Supraleitfähigkeit - Teil 7: Charakteristische elektronische Messungen - Oberflächenwiderstand von Supraleitern bei Frequenzen im Mikrowellenbereich (IEC 61788-7:2020)

Supraconductivité - Partie 7: Mesures des caractéristiques électroniques - Résistance de surface des supraconducteurs aux hyperfréquences (IEC 61788-7:2020)

Ta slovenski standard je istoveten z: **EN IEC 61788-7:2020**

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 IEC 61788-7:2020 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 61788-7

May 2020

ICS 29.050; 17.220.20

Supersedes EN 61788-7:2006 and all of its amendments and corrigenda (if any)

English Version

Superconductivity - Part 7: Electronic characteristic measurements - Surface resistance of high-temperature superconductors at microwave frequencies (IEC 61788-7:2020)

Supraconductivité - Partie 7: Mesurages des caractéristiques électronique - Résistance de surface des supraconducteurs haute température critique aux hyperfréquences (IEC 61788-7:2020)

Supraleitfähigkeit - Teil 7: Messungen der elektronischen Charakteristik - Oberflächenwiderstand von Hochtemperatur-Supraleitern bei Frequenzen im Mikrowellenbereich (IEC 61788-7:2020)

This European Standard was approved by CENELEC on 2020-04-24. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 90/447/FDIS, future edition 3 of IEC 61788-7, prepared by IEC/TC 90 "Superconductivity" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61788-7:2020.

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)	2021-01-24
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2023-04-24

This document supersedes EN 61788-7:2006 and all of its amendments and corrigenda (if any).

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

Endorsement notice

The text of the International Standard IEC 61788-7:2020 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

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

IEC 61788-7

Edition 3.0 2020-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Superconductivity –
Part 7: Electronic characteristic measurements – Surface resistance of high-temperature superconductors at microwave frequencies

Supraconductivité –
Partie 7: Mesurages des caractéristiques électronique – Résistance de surface des supraconducteurs haute température critique aux hyperfréquences

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 17.220.20; 29.050

ISBN 978-2-8322-7917-5

Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

SUPERCONDUCTIVITY –

Part 7: Electronic characteristic measurements – Surface resistance of high-temperature superconductors at microwave frequencies

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 service 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 61788-7 has been prepared by IEC technical committee 90: Superconductivity.

This third edition cancels and replaces the second edition, published in 2006. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) informative Annex B, relative combined standard uncertainty for surface resistance measurement has been added;

b) precision and accuracy statements have been converted to uncertainty;

c) reproducibility in surface resistant measurement has been added.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
90/447/FDIS	90/452/RVD

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

This document 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 document will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the document will be

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

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.

INTRODUCTION

Since the discovery of some Perovskite-type Cu-containing oxides, extensive research and development (R & D) work on high-temperature superconductors (HTS) has been, and is being, done worldwide, and its application to high-field magnet machines, low-loss power transmission, electronics and many other technologies is in progress.

In various fields of electronics, especially in telecommunication fields, microwave passive devices such as filters using HTS are being developed and are undergoing on-site testing [1][1] [2].

Superconductor materials for microwave resonators [3], filters [4], antennas [5] and delay lines [6] have the advantage of very low loss characteristics. The parameters of superconductor materials needed for the design of microwave low loss components are the surface resistance, (R_s) and the temperature dependence of the R_s. Knowledge of this parameter is of primary importance for the development of new materials on the supplier side and for the design of superconductor microwave components on the customer side.

R_s of high quality HTS films is generally several orders of magnitude lower than that of normal metals [7] [8] [9] [10], which has increased the need for a reliable characterization technique to measure this property. Traditionally, the R_s of niobium or any other low-temperature superconducting material was measured by first fabricating an entire three-dimensional resonant cavity and then measuring its Q-value [11]. The R_s could be calculated by solving the electro-magnetic field (EM) distribution inside the cavity. Another technique involves placing a small sample inside a larger cavity. This technique has many forms but usually involves the uncertainty introduced by extracting the loss contribution due to the HTS films from the experimentally measured total loss of the cavity.

The best HTS samples are epitaxial films grown on flat crystalline substrates and no high-quality films have been grown on any curved surface so far. What is needed is a technique that: can use these small flat samples; requires no sample preparation; does not damage or change the film; is highly repeatable; has great sensitivity (down to 1/1 000 the R_s of copper); has great dynamic range (up to the R_s of copper); can reach high internal powers with only modest input powers; and has broad temperature coverage (4,2 K to 150 K).

The dielectric resonator method is selected among several methods to determine the surface resistance at microwave frequencies because it is considered to be the most popular and practical at present. Especially, the sapphire resonator is an excellent tool for measuring the R_s of HTS materials [12] [13] [14]

The test method given in this document can also be applied to other superconductor bulk plates including low T_c materials.

This document is intended to provide an appropriate and agreeable technical base for the time being to engineers working in the fields of electronics and superconductivity technology.

The test method covered in this document is based on the VAMAS (Versailles Project on Advanced Materials and Standards) pre-standardization work on the thin film properties of superconductors.

[1] Numbers in square brackets refer to the bibliography.