



DPC: 24 / 30498362 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 09 August 2024

Origin: International

Latest date for receipt of comments: 31 August 2024

Project No. 2023/02828

Responsible committee: W/- Miscellaneous Standards

Interested committees:

Title: BS EN IEC 61788-28 Mechanical properties measurement - Tensile test of practical REBCO and BSCCO composite superconductors at cryogenic temperatures

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

**WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD.
THIS DRAFT IS NOT CURRENT BEYOND 31 August 2024**

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <http://standardsdevelopment.bsigroup.com>

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



90/527/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: IEC 61788-28 ED1	
DATE OF CIRCULATION: 2024-08-02	CLOSING DATE FOR COMMENTS: 2024-09-27
SUPERSEDES DOCUMENTS: 90/512/CD, 90/520/CC	

IEC TC 90 : SUPERCONDUCTIVITY	
SECRETARIAT: Japan	SECRETARY: Mr Jun Fujikami
OF INTEREST TO THE FOLLOWING COMMITTEES:	HORIZONTAL FUNCTION(S):
ASPECTS CONCERNED:	

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "In Some Countries" clauses. (SEE [AC/22/2007](#) OR [NEW GUIDANCE DOC](#)).

TITLE: Mechanical properties measurement - Tensile test of practical REBCO and BSCCO composite superconductors at cryogenic temperatures
--

NOTE FROM TC/SC OFFICERS:

CONTENTS

3		
4		
5	FOREWORD.....	3
6	INTRODUCTION.....	5
7	1 Scope	6
8	2 Normative references	6
9	3 Terms and definitions	7
10	4 Principle	9
11	5 Apparatus.....	9
12	6 Specimen preparation.....	10
13	7 Testing conditions	11
14	8 Calculation of results	11
15	9 Uncertainty of measurand.....	12
16	10 Test report.....	13
17	Annex A (informative) Additional information relating to measurement, apparatus, and	
18	calculation	14
19	Annex B (informative) Evaluation of combined standard uncertainty for HTS E0 and	
20	Rp0,2_0 measurements	18
21	Bibliography.....	24
22		
23		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SUPERCONDUCTIVITY

Part 28: Mechanical properties measurement – Tensile test of practical REBCO and BSCCO flat tape composite superconductors at liquid nitrogen temperature

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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC [had/had not] received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 661788-28 has been prepared by IEC technical committee 90: SUPERCONDUCTIVITY. It is an International Standard.

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

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

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

The language used for the development of this International Standard is English.

77 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
78 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available
79 at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
80 described in greater detail at www.iec.ch/publications.

81 The committee has decided that the contents of this document will remain unchanged until the
82 stability date indicated on the IEC website under webstore.iec.ch in the data related to the
83 specific document. At this date, the document will be

- 84 • reconfirmed,
- 85 • withdrawn,
- 86 • replaced by a revised edition, or
- 87 • amended.

88

INTRODUCTION

Several types of high-temperature composite superconductors have now been commercialized. The rare-earth-based oxide superconductor (SC) with chemical formula $\text{REBa}_2\text{Cu}_3\text{O}_{7-x}$ is used as practical SC tapes, where the rare-earth element RE is Y, Dy, Gd, Eu, Nd, Ho and Sm or a mixture of them. This type of practical SC tapes is usually called REBCO coated conductors. A typical architecture consists of a substrate of Hastelloy, Ni-W alloy or stainless steel, a buffer layer consisting of plural of oxides, a SC layer and a protection layer of Ag. The substrate and buffer layer act as template to facilitate the well-oriented SC layer. In order to resist the large electromagnet force, the tapes are often externally reinforced by laminating thin stainless steel or copper or copper alloy foils. For electrical and chemical stabilization, the silver layer is deposited on the superconducting layer. Often the additional copper layer is electroplated on the silver layer. Two types of bismuth-based oxide superconductors with chemical formula $(\text{Bi}, \text{Pb})_2\text{Sr}_2\text{Ca}_n-1\text{Cu}_n\text{O}_{2n+4}$ where $n = 2$ or 3 , have been developed as practical SC tapes. In either case, superconducting filaments are embedded into pure silver matrix. In the Bi-2223 tapes, a silver alloy outer sheath surrounds the matrix for increasing mechanical strength. Bi-2223 tapes are exclusively made in flat tape-shaped form. Tapes are commercially available in which thin metallic sheets of copper alloy or stainless steel, or nickel alloy are soldered on both sides of the SC tapes to improve the strain dependence of critical current and the mechanical properties. Practical composite superconductors have a high current density and a small cross-sectional area. The major application of composite superconductors is to build electrical power devices and superconducting magnets. For example, while the magnet is manufactured, complicated stresses/strains are applied to its windings and, while it is energized, a large electromagnetic force is applied to the superconducting tapes because of its high current density. Room temperature mechanical properties are insufficient for an HTS magnet operation. It is therefore important to measure the mechanical properties of the practical SC tapes at both room temperature and at cryogenic temperatures.

SUPERCONDUCTIVITY

Part 28: Second Mechanical properties measurement – Tensile test of practical REBCO and BSCCO flat tape composite superconductors at liquid nitrogen temperature

1 Scope

This part of IEC 61788 covers a test method detailing the tensile test procedures to be carried out on practical REBCO and BSCCO superconductive composite tapes at cryogenic temperatures. This test is used to measure the modulus of elasticity and 0,2% proof strength. The values for elastic limit, fracture strength and percentage elongation after fracture shall serve only as a reference. The sample covered by this test procedure for REBCO tapes should have a rectangular cross-section with an area of 0,06 mm² to 4,0 mm² (corresponding to the tapes with width of 2,0 mm to 20,0 mm and thickness of 0,03 mm to 0,2 mm). The sample covered by this test procedure for BSCCO tapes should have rectangular cross-section with an area of 0,3 mm² to 2,5 mm² (corresponding to the tape-shaped tapes with width of 2,0 mm to 5,0 mm and thickness of 0,15 mm to 0,5 mm).

2 Normative references

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.

IEC 60050-815:2015, *International Electrotechnical Vocabulary (IEV) – Part 815: Superconductivity*

IEC 61788-21 Ed. 1: *Superconductivity - Part 21: Superconducting tapes – Test Methods for Practical Superconducting Tapes, General Characteristics and Guidance*

IEC 61788-6, Ed.3: *Superconductivity – Part 6: Mechanical properties measurement – Room temperature tensile test of Cu/Nb-Ti composite superconductors*

IEC 61788-18, Ed. 1: *Superconductivity – Part 18: Mechanical properties measurement – Room temperature tensile test of BSCCO composite superconductors*

IEC 61788-19, Ed. 1: *Superconductivity – Part 19: Mechanical properties measurement – Room temperature tensile test of Nb₃Sn composite superconductors*

IEC 61788-25, Ed. 1: *Superconductivity – Part 25: Mechanical properties measurement – Room temperature tensile test of REBCO composite superconductors*

ISO 376:2011 *Metallic materials — Calibration of force-proving instruments used for the verification of uniaxial testing machines*

ISO/AWI 6892-6, *Metallic materials — Tensile testing* Part 6: *Tensile test on foils and strips of metals with a nominal thickness less than 0,200 mm by using computer-controlled testing machines*

ISO 7500-1:2018 *Metallic materials — Calibration and verification of static uniaxial testing machines* Part 1: *Tension/compression testing machines — Calibration and verification of the force-measuring system*