IEC 61788-21

Edition 1.0 2015-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Superconductivity –
Part 21: Superconducting wires – Test methods for practical superconducting wires – General characteristics and guidance

Supraconductivité –
Partie 21: Fils supraconducteurs – Méthodes d'essai pour fils supraconducteurs à usage pratique – Caractéristiques générales et lignes directrices

IEC 61788-21:2015-05(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 17.220; 29.050; 77.040.10

ISBN 978-2-8322-2691-9

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SUPERCONDUCTIVITY –

Part 21: Superconducting wires – Test methods for practical superconducting wires – General characteristics and guidance

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

FDIS	Report on voting
90/353/FDIS	90/354/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 the parts in the IEC 61788 series, published under the general title *Superconductivity,* can be found on the IEC website.

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INTRODUCTION

Superconducting (SC) wires are a central and often enabling technology of many important industrial products. Consensus-based standards for SC wires greatly facilitate the creation of procurement specifications, design and engineering of components, certification of quality, description of operating devices, and generalization of use in industrial technologies.

This part of IEC 61788 is ranked as a first priority for both producers and users of superconducting technology: It provides the measurement methods and test procedures for properties critical to use. Adherence to normative information assists the development of commercial markets and the distribution of products. Standardization in this regard is meant to provide common access to, and unarguable reference information about, characteristics that are most important for superconductor-based technologies.

This part of IEC 61788 includes the measurement principles and measurement techniques together with the relevant terminology and definitions. Specifications of SC wire products take into account the function of the different components of SC wires to meet operational needs, maintain operational (superconducting) conditions, and accommodate mechanical forces and strains. The various forms of SC wire products distributed by manufacturers incorporate these aspects to varying degrees, depending on the superconducting materials used and the intended operating conditions/environment. Design and engineering of devices that use SC wire products take into account the unique properties of SC wires during operation. The general features of practical SC wires are described in IEC TR 61788-20 in terms of simple general characteristics to assist in the specification and use of superconducting wire products. Testing, certification, and quality control apply the relevant standard test methods to SC wires, which are specified in this part of IEC 61788.

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SUPERCONDUCTIVITY –

Part 21: Superconducting wires – Test methods for practical superconducting wires – General characteristics and guidance

1 Scope

This part of IEC 61788 specifies the test methods used for validating the mechanical, electrical, and superconducting properties of practical SC wires. A wire is considered as being practical if it can be procured in sufficiently continuous lengths under ordinary commercial transactions to build devices. Conductors made of multiple wires, such as cables, are not included in the scope of this part of IEC 61788. Extension of the discussions in this part of IEC 61788 beyond practical SC wires is not intended, even though referenced documents include aspects outside of this scope.

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 (all parts), *International Electrotechnical Vocabulary.* Available from: http://www.electropedia.org

IEC 61788-1, *Superconductivity – Part 1: Critical current measurement – DC critical current of Nb-Ti composite superconductors*

IEC 61788-2, *Superconductivity – Part 2: Critical current measurement – DC critical current of Nb_3Sn composite superconductors*

IEC 61788-3, *Superconductivity – Part 3: Critical current measurement – DC critical current of Ag- and/or Ag alloy-sheathed Bi-2212 and Bi-2223 oxide superconductors*

IEC 61788-4, *Superconductivity – Part 4: Residual resistance ratio measurement – Residual resistance ratio of Nb-Ti composite superconductors*

IEC 61788-5, *Superconductivity – Part 5: Matrix to superconductor volume ratio measurement – Copper to superconductor volume ratio of Cu/Nb-Ti composite superconducting wires*

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

IEC 61788-8, *Superconductivity – Part 8: AC loss measurements – Total AC loss measurement of round superconducting wires exposed to a transverse alternating magnetic field at liquid helium temperature by a pickup coil method*

IEC 61788-10, *Superconductivity – Part 10: Critical temperature measurement – Critical temperature of composite superconductors by a resistance method*

IEC 61788-11, *Superconductivity – Part 11: Residual resistance ratio measurement – Residual resistance ratio of Nb_3Sn composite superconductors*

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IEC 61788-12, *Superconductivity – Part 12: Matrix to superconductor volume ratio measurement – Copper to non-copper volume ratio of Nb_3Sn composite superconducting wires*

IEC 61788-13, *Superconductivity – Part 13: AC loss measurements – Magnetometer methods for hysteresis loss in superconducting multifilamentary composites*

IEC 61788-18, *Superconductivity – Part 18: Mechanical properties measurement – Room temperature tensile test of Ag- and/or Ag alloy-sheathed Bi-2223 and Bi-2212 composite superconductors*

IEC 61788-19, *Superconductivity – Part 19: Mechanical properties measurement – Room temperature tensile test of reacted Nb_3Sn composite superconductors*

3 Terms and definitions

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

4 Characteristic attributes of practical SC wires

The primary purpose of electrical wires is to carry electrical current. Practical SC wires have the same intended purpose as common electrical wires, with the special ability to carry hundreds or thousands of times more current than a common electrical wire of the same dimension. Standard test methods discussed in this part of IEC 61788 address the determination of current-carrying capacity, called the critical current of practical SC wires. Several by-products of the special circumstances of practical SC wires also necessitate additional standards discussed in this part of IEC 61788 with respect to mechanical and thermal properties as well as properties in magnetic fields. The details are described in Annex A.

5 Categories of properties

The properties necessary for the specification are categorized as follows:

a) properties referring to the operation of SC wires, e.g. incurred during the initial cool-down to operating temperature, standard continuous operation, and under fault conditions;

b) properties related to implementation and engineering, e.g. incurred during the fabrication and installation of a device.

With respect to the properties belonging to two categories, their principal test methods have been established as parts of IEC 61788 series indicated in Clause 6.

6 Properties governed by IEC standards

6.1 General

Several attributes are governed by parts of the IEC 61788 series. Test methods for these attributes shall be used to settle disputes. When a new test method is established as a part of IEC 61788 series, it will be included in Clause 6.

6.2 Properties referring to the operation of SC wires

For the purpose of consultation, current parts of the IEC 61788 series related to specific properties shall be used to settle disputes. They are categorized in groups as follows.

a) Critical temperature:

– Critical temperature measurement – Critical temperature of composite superconductors by a resistance method (IEC 61788-10).

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