

TECHNICAL REPORT

Superconductivity – **STANDARD PREVIEW**
Part 20: Superconducting wires – Categories of practical superconducting
wires – General characteristics and guidance
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TECHNICAL REPORT

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SUPERCONDUCTIVITY –**Part 20: Superconducting wires –
Categories of practical superconducting wires –
General characteristics and guidance**

FOREWORD

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IEC 61788-20, which is a technical report, has been prepared by IEC technical committee 90: Superconductivity.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
90/335/DTR	90/344/RVC

Full information on the voting for the approval of this technical report 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 parts of the IEC 61788-20 series, published under the general title *Superconductivity*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

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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.

The present technical report (TR IEC61788-20) provides a description of the general features of practical SC wires. The practical low temperature superconducting (LTS) wires have been used extensively in a variety of applications since the late 1960s. These applications include magnetic resonance imaging magnets, research and accelerator magnets, and systems for cutting-edge scientific research. High temperature superconductors (HTS), discovered in 1986, allow operation of superconductor-based technologies with less expensive and more efficient refrigeration systems. These new materials will provide wires that will enable new applications, some of which may not be possible with LTS wires. Many fabrication routes and conductor architectures are well established for superconducting wires, and these engineering routes have a number of general characteristics that are fundamental to enabling industrial products.

Practical superconducting wires are those forms of SC wires that are nearly identical to other common electrical conductors such as those made from copper or aluminium. The appearance of low temperature superconductive wires is, for instance, very similar to commercial electrical copper wires or tin-plated copper wires, because they are covered with stabilization or reinforcing components consisting of metallic elements. Often practical SC wires are supplied in long lengths on wire spools. As such, practical SC wires can be used in products and applications almost interchangeably with common wires. The technical aspects of superconductivity impose, however, certain considerations that might be taken into account in specifications for procurement, design and engineering, testing and certification, quality control, and other commerce. These aspects can be complicated, making practical SC wires less accessible to the non-technical user despite the best efforts of SC wire suppliers to market their products. This document intends to provide descriptions of the technical aspects of practical SC wires in terms of simple general characteristics to assist in the specification and use of superconducting wire products. It might be noted that this document gives some general characteristics of practical SC wires at the present state, but not any type of specifications for the wires or for the processing of the wire.

Thus the present technical report that provides general characteristics and guidance with respect to practical SC wires is recommended as a first priority for both producers and users of superconducting technology.

SUPERCONDUCTIVITY –

Part 20: Superconducting wires – Categories of practical superconducting wires – General characteristics and guidance

1 Scope

This part of IEC 61788, which is a technical report, provides general characteristics and guidance on practical SC wires. Particular focus is given to the characteristics that are different from those of ordinary copper and aluminium wires, since practical SC wires have appearance nearly identical to common electrical wires and can be used interchangeably with them. On the other hand, the practical SC wires are typically composite materials consisting of several functional materials as described in Annex A.

Many forms of SC wires are described in Section 4 of IEC 60050-815, including single core wires, multi-filamentary superconducting wires, composite superconductors and coated conductors. These wires as well as others that might be described as monolithic composite superconducting wires will be the focus in this technical report. 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, for example, are not included in this scope.

Since this report only addresses the characteristics of practical wires, other wires such as prototype, test sample and developmental wires are not included in the scope of this technical report.

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 at: <<http://www.electropedia.org>>)

3 Terms and definitions

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

4 Categories of practical SC wires

Industrially available SC materials are classified into two categories by IEC 60050-815. The low temperature superconductors have a critical temperature less than 25 K. They are typically in the Nb-Ti group and Nb₃Sn group, which is an intermetallic compound. The other category consists of high temperature superconductors such as BSCCO and REBCO and the intermetallic compound MgB₂. In the present document, the five types of SC wire based on the aforementioned five superconductor materials may be prescribed as practical SC wires, of which the additional details are mentioned in Annexes A and B. When a new superconducting

material is industrialized into wire form in the future, the current general requirements should be modified by introducing it as a new practical SC wire.

5 Technical sheet assisting in the specification and the use of practical SC wires

General items to agree between the supplier and the customer at the time of contract or purchase order are listed as follows. Except the recommended items mentioned here, additional items providing for the specification are described in Annex C. The technical sheet may be executed.

6 Class of practical SC wires

One of the practical SC wires described in Clause 4 may be specified.

Additional informative items are mentioned in Annex B.

7 Product parameters

- Dimension may be settled in terms of the diameter of the round wire or the width / thickness of the rectangular wire together with the tolerance.
- Length and/or weight may be definitely settled.
- The necessity of insulation may be designated.
- The type of spooling may be designated.
- The shipping label designated in Clause 13 may be attached on the shipped product.

Additional informative items are mentioned in Annex C.

8 Joints

Unless otherwise agreed upon by a customer and a supplier, no joints may be made in the completed wire. If joints are permitted within the wire, the customer and supplier are required to agree on the quantity and properties of the joints.

9 Appearance

The appearance of the wire should be free from any imperfection not consistent with commercial practice.

Additional informative items are mentioned in Annex C.

10 Quality assurance

A representative critical current value may be designated together with tolerance.

Additional informative items are mentioned in Annex C.

11 Test methods

Tests to determine conformance to requirements on product parameter and quality may be performed according to the instruction of the document (see Bibliography).

12 Inspection

Unless otherwise specified in the contract or purchase order, the supplier may be responsible for the performance of all inspection and test requirements specified.

Unless otherwise agreed upon between the customer and the supplier, conformance of the wire to the various requirements listed in this specification may be determined on samples taken from each lot of wire presented for acceptance.

13 Shipping label

The following information may be supplied with the product shipping label:

- a heading title “Superconducting wire” and/or the name of the principal SC material, and/or product identification such as a trade name;
- manufacturer;
- manufacturing date;
- country of origin;
- information guaranteeing traceability by the manufacturer, such as lot number or billet number.

Further information is mentioned in Annex C.

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