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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 45982.1-2025

**Micro joining of 2nd generation high temperature
superconductors - Part 1: General requirements for the
procedure**

第二代高温超导体微连接 第1部分：工艺要求

(English Translation)

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Foreword

This document is in accordance with the rules of GB/T 1.1-2020 "Guidelines for standardization work Part 1: Structure and drafting rules for standardization documents" Drafting.

This document is Part 1 of GB/T 45982 "Micro-connections of the second generation of high temperature superconductors".

MicroConnect has published the following sections.

- Part 1: Process requirements;
- Part 2: Qualification of welding and testing personnel;
- Part 3: Test methods for joints.

This document is modified to adopt ISO 17279-1:2018 "Welding of second-generation high-temperature superconductors - Microjoints - Part 1: General process requirements".

This document has the following structural adjustments compared to ISO 17279-1:2018.

- a) 3.2 corresponds to 3.3 in ISO 17279-1:2018;

- b) 3.3 corresponds to 3.5 in ISO 17279-1:2018;
- c) 3.5 corresponds to 3.7 in ISO 17279-1:2018;
- d) 5.5.4.9 corresponds to 5.5.4.10 in ISO 17279-1:2018;
- e) 5.5.4.10 corresponds to 5.5.4.11 in ISO 17279-1:2018.

The technical differences between this document and ISO 17279-1:2018 and their reasons are as follows.

- a) deleted the contents that are not within the scope of this document (see Chapter 1 of ISO 17279-1:2018);
- b) Added the definition documents GB/T 2900.100 and GB/T 3375 (see Chapter 3) to facilitate the use of this document.
application;
- c) Added the normative reference document GB/T 19866 (see Chapter 3), deleted ISO/T R25901 (all parts) (see Chapter 3 of ISO 17279-1:2018) replaces ISO 17279-2 (see 5.5.1, 5.5.3.1 and 5.5.4.1), the normative reference document GB/T 45982.3 replaces ISO 17279-3 (see 5.4.1, 5.5.4.1 and 5.7) to suit my country's technical conditions;
- d) The terms and definitions "low-temperature superconductor", "pressurized partial micro-melting diffusion" and "pressurized solid-state diffusion" have been deleted (see ISO 17279-1:2018 3.2, 3.4, and 3.6);
- e) Added the term and definition of "lap joint" (see 3.4), deleted the normative reference ISO 15607:2003 (see 2 of ISO 17279-1:2018) and Table 1 of ISO 15607:2003 (see ISO 17279-1:2018, Clause 2) and the symbols and abbreviations in Table 1 of ISO 15607:2003 (2018), to facilitate the application of this document;
- f) Added explanations of 6 symbols (see Chapter 4) to facilitate the application of this document;
- g) Added some parameters that need to be set in the micro-connection and oxidation annealing processes [see 5.5.3.2c) and 5.5.3.4c)], which are implemented Essential test parameters in the process to improve the operability of the process;
- h) A sampling step after the oxidation annealing process is added [see 5.5.3.3i)] to improve the operability of the process and eliminate ambiguity;
- i) Deleted the verification and acceptance criteria for the joint Jc in the four-lead method test (see 5.5.4.2, 5.5.4.4 and 5.5.5.6 of ISO 17279-1:2018)
Table 5 in 5.9) to apply my country's technical conditions;
- j) Deleted the critical magnetic field test requirements and the acceptance criteria for joints

using the critical magnetic field test (see ISO 17279-1:2018

Table 10 in 5.5.4.2, 5.5.4.9 and 5.9);

k) Scanning electron microscopy, transmission electron microscopy and X-ray diffraction tests (see ISO 17279-1:2018) have been deleted.

5.5.4.2 and 5.5.4.11) to apply my country's technical conditions;

l) Deleted the acceptance criteria for the four-lead method test in the manufacture of nuclear magnetic resonance or magnetic resonance imaging magnets (see ISO 17279.1.

(Table 5 in 5.9 of 2018).

m) The acceptance criteria for joint resistance in the magnetic field attenuation test (see Table 6 in 5.9) have been changed to suit my country's technical requirements;

n) The acceptance criteria for the bending test (see Table 9 in 5.9) have been changed to suit my country's technical requirements.

The following editorial changes have been made to this document.

a) To coordinate with the existing standard, the name of the standard is changed to "Second Generation High-Temperature Superconductor Microconnection Part 1: Process Requirements";

b) Added some figure legends (see Figure 4, Figure 5, Figure 8, Figure B.1, Figure B.2, Figure C.1, Figure C.2, Figure D.1, Figure D.2);

c) Changed the index numbers of the micro-joining and oxidation annealing process curves (see 5.4.1, Appendix B, Appendix C, Appendix D);

d) Changed the oxidation annealing process step sequence number (see 5.5.3.3);

e) Added introductory words and titles to the tables (see Tables A.1 to A.3 in Appendix A and Tables E.1 to E.3 in Appendix E);

f) Added some parameters required in the process checklist (see Table A.1 and Table A.3 in Appendix A);

g) Added the sampling step in the oxidation annealing process checklist (see Table A.2 in Appendix A);

h) Deleted the sampling steps in the micro-joining and oxidation annealing process checklist (see Table A.3 in Appendix A), and changed some inspection steps.

Steps (see Table A.3 in Appendix A);

i) Deleted some notes (see 5.2, 5.5.3.3, 5.5.3.4, Annex B, Annex C and Annex D of ISO 17279-1:2018);

- j) Deleted the redundant statements in this section (see 5.2 and 5.3 of ISO 17279-1:2018);
- k) Deleted some explanatory descriptive content (see 5.4.1, 5.5.2, 5.5.3.2, 5.5.3.4, 5.5.4.4, Table A.1 and Table A.3 in Appendix A);
- l) The test results of the critical magnetic field test and X-ray diffraction test have been deleted (see Annex C of ISO 17279-1:2018).

Introduction

With the widespread application of the second generation of high temperature superconductors (2GHTS) and the invention of 2GHTS resistance-free connection technology, it is necessary to formulate this document ensures that 2GHTS are connected in the most efficient way and that all implementation processes are properly controlled.

In order to ensure the quality of 2GHTS joints, it is necessary to formulate national standards for micro-joining process and joint evaluation specifications.

"Conductor Microconnection" is a universal management standard for microconnections of second-generation high-temperature superconductors, and is intended to consist of three parts.

- Part 1: Process requirements;
- Part 2: Qualification of welding and testing personnel;
- Part 3: Test methods for joints.

Superconducting materials have zero resistance conduction and complete anti-magnetism below the critical temperature T_c , critical magnetic field strength B_c and critical current density J_c .

Once activated, current will flow forever in the diamagnetic closed loop of the superconducting material.

2GHTS consists of multiple layers with a total thickness of about $60\mu\text{m}\sim 100\mu\text{m}$, with or without copper stabilization layer coating.

The thickness of the superconducting layer prepared by (REBCO) is only $1\mu\text{m}\sim 3\mu\text{m}$, depending on the specifications of 2GHTS. Re represents rare earth materials, including

Figure 1 is a schematic diagram of the multilayer structure of a typical 2GHTS, and indicates the composition of each layer including the copper stabilization layer.

The two copper stabilization layers numbered 1 in FIG1 do not exist in the 2GHTS without stabilization layer.

Index number description.