ICS 25.160.01 SLOVENSKÁ TECHNICKÁ NORMA August 2021

| STN | **Zváranie<br>Mikrospájanie druhej generácie vysokoteplotných supravodičov<br>Časť 3: Metódy skúšania spojov (ISO 17279-3: 2021)** | **STN<br>EN ISO 17279-3**<br><br>05 0350 |
|---|---|---|

Welding - Micro joining of second generation high temperature superconductors - Part 3: Test methods for joints (ISO 17279-3:2021)

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 07/21

Obsahuje: EN ISO 17279-3:2021, ISO 17279-3:2021



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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN ISO 17279-3

March 2021

ICS 25.160.01

English Version

# Welding - Micro joining of second generation high temperature superconductors - Part 3: Test methods for joints (ISO 17279-3:2021)

Soudage - Micro-assemblage des supraconducteurs à haute température de deuxième génération - Partie 3: Méthode d'essai des assemblages (ISO 17279-3:2021)

Schweißen - Mikrofügen von Hochtemperatursupraleitern der 2. Generation - Teil 3: Prüfverfahren von Fügeverbindungen (ISO 17279-3:2021)

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Ref. No. EN ISO 17279-3:2021 E

**EN ISO 17279-3:2021 (E)**

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# European foreword

This document (EN ISO 17279-3:2021) has been prepared by Technical Committee ISO/TC 44 "Welding and allied processes" in collaboration with Technical Committee CEN/TC 121 “Welding and allied processes” the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2021, and conflicting national standards shall be withdrawn at the latest by September 2021.

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INTERNATIONAL STANDARD

**ISO 17279-3**

First edition
2021-02

# Welding — Micro joining of second generation high temperature superconductors —

## Part 3: Test methods for joints

*Soudage — Micro-assemblage des supraconducteurs à haute température de deuxième génération —*

*Partie 3: Méthode d'essai des assemblages*

Reference number
ISO 17279-3:2021(E)

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**ISO 17279-3:2021(E)**

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# Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Quality management in the field of welding,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 17279 series can be found on the ISO website.

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Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html.

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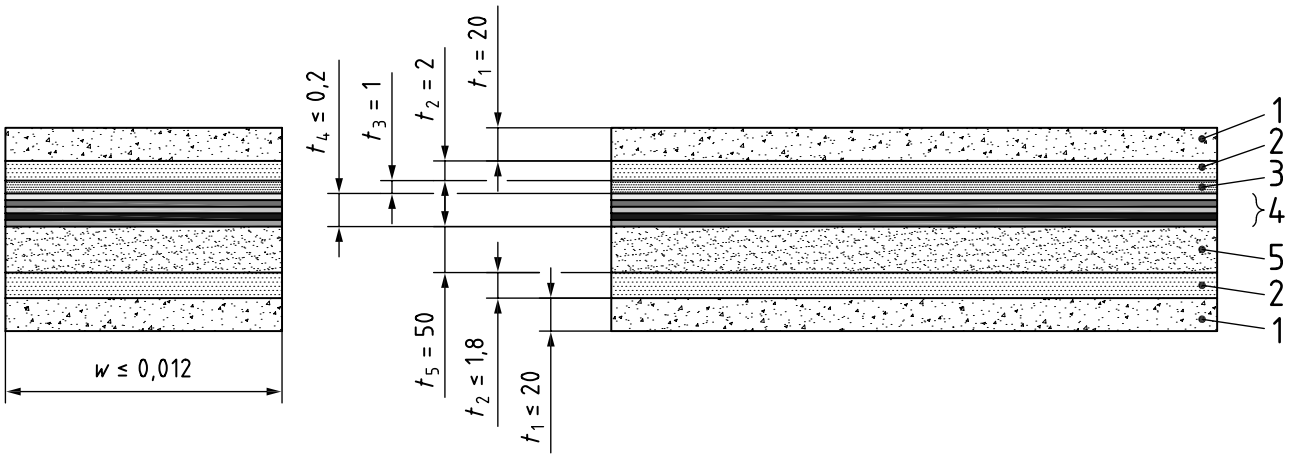
# Introduction

The increasing use of second-generation high temperature superconductors (2G HTSs) and invention of resistance-free joining on 2G HTSs have created the need for the ISO 17279 series in order to ensure that joining is carried out in the most effective way and that appropriate control is exercised over all aspects of the operation. ISO standards for micro-joining and joint evaluation procedure are accordingly essential to get the best and uniform quality of 2G HTS joint.

Superconductor is a material that conducts electricity without resistance and has diamagnetism below critical temperature ($T_c$), critical magnetic field ($B_c$) and critical current density ($J_c$). Once set in motion, electrical current flows forever in a closed loop of superconducting material under diamagnetism.

2G HTS constitutes of multi-layers and total thickness is around 60 µm to 90 µm and the superconducting layer made from $REBa_2Cu_3O_{7-x}$ is only 1 µm to 3 µm thick depending on manufacturer's specifications. Figure 1 shows schematic drawing of typical multiple layers, and the constituents and thicknesses of each layer in the 2G HTS.

Dimensions in micro-meters




**Key**

| | | | |
|---|---|---|---|
| 1 | Cu stabilizer | $t_1$ | thickness of layer 1 |
| 2 | Ag overlayer | $t_2$ | thickness of layer 2 |
| 3 | REBCO-superconducting layer | $t_3$ | thickness of layer 3 |
| 4 | buffer stack | $t_4$ | thickness of layer 4 |
| 5 | hastelloy®C-276 substrate | $t_5$ | thickness of layer 5 |

NOTE Not to scale.

**Figure 1 — Typical 2G HTS multi-layers, and the constituents and thicknesses of each layer**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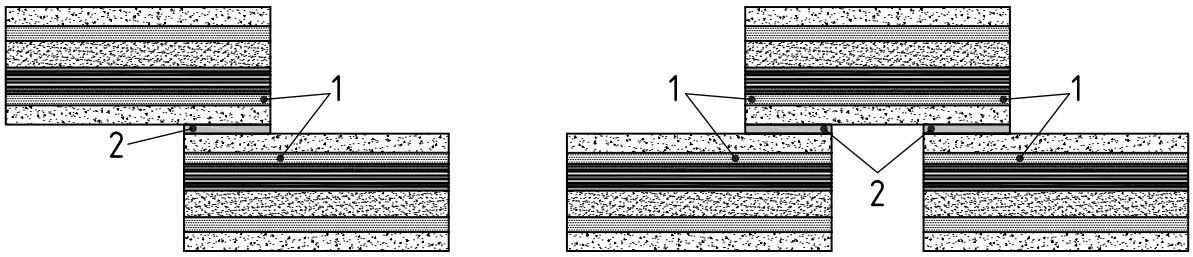
Currently soldering, brazing or any filler is applying in superconducting industry as shown in Figure 2, which shows high electrical resistance at the joint providing fatal flaw in the superconductor.




**a) Lap joint** **b) Bridge joint**

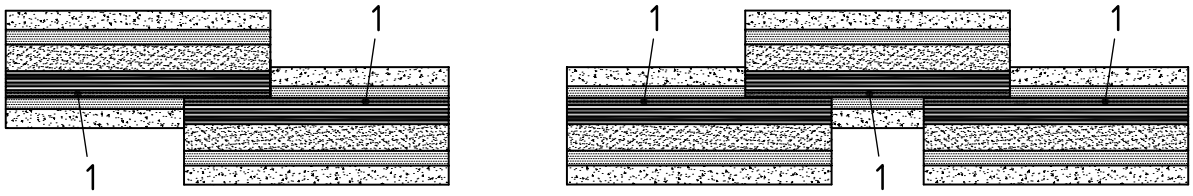
**Key**

1 REBCO-superconducting layer

2 solder

**Figure 2 — Soldering to join 2G HTS**

However, the ISO 17279 series focuses on the direct autogenous joining of 1 µm to 3 µm thick superconducting layers of 2G HTSs as shown in Figure 3 without filler metals and recovery of superconducting properties by oxygenation annealing process, which shows almost none electrical resistance at the joint.




**a) Lap joint** **b) Bridge joint**

**Key**

1 REBCO-superconducting layer

**Figure 3 — Direct autogenous joining of 1 µm to 3 µm thick superconducting layers of 2G HTSs for superconducting joint**

ISO 17279-1 specifies requirements for the qualification of 2G HTS joining procedure. 2G HTS joints should be capable of performing required electric, magnetic and mechanical properties and free from serious imperfections in production and in service. To achieve that goal, it is necessary to provide controls during design and fabrication.

ISO 17279-2 specifies requirements for the qualification of personnel performing welding and testing.

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**INTERNATIONAL STANDARD** **ISO 17279-3:2021(E)**

# Welding — Micro joining of second generation high temperature superconductors —

# Part 3: Test methods for joints

## 1 Scope

This document specifies the requirements for the test methods for joint of micro-joining of 2G HTS to fulfil the requirements of ISO 17279-1 and ISO 17279-2.

This document specifies test methods for determining the capability of joints for the production of the specified quality. It defines specific test requirements, but does not assign those requirements to any specific product group.

## 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.

ISO 17279-1:2018, *Welding — Micro joining of 2nd generation high temperature superconductors — Part 1: General requirements for the procedure*

ISO 15607:2019, *Specification and qualification of welding procedures for metallic materials — General rules*

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