SLOVENSKI STANDARD
oSIST prEN IEC 60352-9:2023

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Spoji brez spajke - 9. del: Ultrazvočno varjeni priključki - Splošne zahteve, preskusne metode in praktični napotki

Solderless connections - Part 9: Ultrasonically welded connections - General requirements, test methods and practical guidance

Ta slovenski standard je istoveten z: **prEN IEC 60352-9:2023**

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IEC

48B/3018/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

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IEC SC 48B : ELECTRICAL CONNECTORS	
SECRETARIAT: United States of America	SECRETARY: Mr Jeffrey Toran
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY

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Attention IEC-CENELEC parallel voting

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

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,
- any relevant "in some countries" clauses to be included should this proposal proceed. Recipients are reminded that the enquiry stage is the final stage for submitting "in some countries" clauses. See AC/22/2007.

TITLE:

Solderless connections - Part 9: Ultrasonically welded connections – General requirements, test methods and practical guidance

PROPOSED STABILITY DATE: 2026

NOTE FROM TC/SC OFFICERS:

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SOLDERLESS CONNECTIONS

Part 9: Ultrasonically welded connections – General requirements, test methods and practical guidance

FOREWORD

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IEC 60352-9 has been prepared by subcommittee SC 48B: Electrical connectors, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronical equipment. It is an International Standard.

The text of this an 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.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available

294 at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
295 described in greater detail at www.iec.ch/standardsdev/publications.

296 The committee has decided that the contents of this document will remain unchanged until the
297 stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to
298 the specific document. At this date, the document will be

299 • reconfirmed,
300 • withdrawn,
301 • replaced by a revised edition, or
302 • amended.
303

INTRODUCTION

Ultrasonic welding is a form of cold friction welding that is becoming increasingly popular in many industries. This type of welding uses ultrasonic vibrations to join materials together, creating a bond that is both strong and reliable. Ultrasonic welding has been identified as process ISO 4063-41 by the International Organization for Standardization (ISO).

The process of ultrasonic welding relies on high frequency ultrasound waves being used to create frictional heat at the connection point. High temperature is not required for this special method of welding, making it one of the most cost-effective ways to join two materials together. It also requires fewer steps than traditional methods, meaning it can be completed quickly and with minimal resources.

Ultrasonic welding has been around for decades but only recently has become more widely utilized due to advances in technology and its availability at lower costs. It can be used on many different materials including plastics, rubbers, metals, textiles, and composites. Due to its precision and strong bonds it creates, it has become extremely popular in manufacturing processes such as automotive industry, electronics industry, furniture production and even medical device production.

This document outlines a system of product classification according to the intended use of the end-product. Three general end-product levels, known as Class A, B, and C products, are identified. Class A products are for general use and include consumer products, computers, and computer peripherals for applications where the major requirement is function of the assembly. Class B products are dedicated service electronic items providing high performance and extended life. Finally, Class C products are for high performance with zero tolerance for equipment downtime; this includes life support systems and other critical systems. The developer or user of ultrasonically welded connections should determine the class to which their end-product belongs.

This document outlines the test requirements for ultrasonically welded connections deemed to be used in class A, B and C products. Test groups P0-P11 are specified, with additional optional test groups P9 and P12 available if required by the manufacturer and user. These tests represent the minimum requirements for each product class.

IEC Guideline 109 advocates the need to minimize the environmental impact of a product during its life cycle phases. It is anticipated that some of the materials, manufacturing and assembly processes approved under this standard may have adverse effects on the environment. In this case, these materials, manufacturing, and assembly processes should be avoided. If further technological developments lead to acceptable alternatives for these materials, they shall be tested according to test program C.

SOLDERLESS CONNECTIONS

Part 9: Ultrasonically welded connections – General requirements, test methods and practical guidance

1 Scope

IEC 60352-9 that provides guidelines for welding and testing of ultrasonically welded connections.

This document covers the requirements for ultrasonically welded connections with wires made of copper or a copper alloy, as well as aluminium or aluminium alloy. These welded metal to metal connections should have a stranded wire cross-sectional area of 0,08 mm² to 160 mm² and not exceed a total cross-sectional area of 200 mm². For aluminium or aluminium alloys, the minimum required cross-sectional area is 2,5 mm². Additionally, information on materials, data from industrial experience and test procedures are included to ensure electrically stable connections under prescribed environmental conditions. Lastly, this document aims to achieve comparable results when using ultrasonic welding equipment with similar performance and specifications as the termination manufacturers.

NOTE – Figures in this document demonstrate possible solutions of ultrasonic connections (for example of rectangular shape), but not restricted to the solution displayed.

2 Normative references

The following documents are referred to in the text in such a way that some or all 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(581), *International Electrotechnical Vocabulary (IEV) – Part 581 – Electromechanical components for electronic equipment*

IEC 60050(841), *International Electrotechnical Vocabulary (IEV) – Part 841 – Industrial electroheat*

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60512-1, *Connectors for electrical and electronic equipment - Tests and measurements - Part 1: Generic specification*

IEC 60512-1-1, *Connectors for electronic equipment - Tests and measurements - Part 1-1: General examination - Test 1a: Visual examination*

IEC 60512-1-2, *Connectors for electronic equipment - Tests and measurements - Part 1-2: General examination - Test 1b: Examination of dimension and mass*

IEC 60512-2-1, *Connectors for electronic equipment - Tests and measurements - Part 2-1: Electrical continuity and contact resistance tests - Test 2a: Contact resistance - Millivolt level method*

IEC 60512-2-2, *Connectors for electronic equipment - Tests and measurements - Part 2-2: Electrical continuity and contact resistance tests - Test 2b: Contact resistance - Specified test current method*

IEC 60512-2-5, *Connectors for electronic equipment - Tests and measurements - Part 2-5: Electrical continuity and contact resistance tests - Test 2e: Contact disturbance*

IEC 60512-3-1, *Connectors for electronic equipment - Tests and measurements - Part 3-1: Insulation tests - Test 3a: Insulation resistance*

IEC 60512-4-1, *Connectors for electronic equipment - Tests and measurements - Part 4-1: Voltage stress tests - Test 4a: Voltage proof*

IEC 60512-5-2, *Connectors for electronic equipment - Tests and measurements - Part 5-2: Current-carrying capacity tests - Test 5b: Current-temperature derating*

IEC 60512-6-4, *Connectors for electronic equipment - Tests and measurements - Part 6-4: Dynamic stress tests - Test 6d: Vibration (sinusoidal)*

IEC 60512-11-1*, Connectors for electrical and electronic equipment - Tests and measurements - Part 11-1: Climatic tests - Test 11a - Climatic sequence*

IEC 60512-11-4, *Connectors for electronic equipment - Tests and measurements - Part 11-4: Climatic tests - Test 11d: Rapid change of temperature*

IEC 60512-11-7*, Connectors for electronic equipment - Tests and measurements - Part 11-7: Climatic tests - Test 11g: Flowing mixed gas corrosion test*

IEC 60512-11-9*, Connectors for electronic equipment - Tests and measurements - Part 11-9: Climatic tests - Test 11i: Dry heat*

IEC 60512-11-10*, Connectors for electronic equipment - Tests and measurements - Part 11-10: Climatic tests - Test 11j: Cold*

IEC 60512-11-12, *Connectors for electronic equipment - Tests and measurements - Part 11-12: Climatic tests - Test 11m: Damp heat, cyclic*

IEC 60512-16-4*, Connectors for electronic equipment - Tests and measurements - Part 16-4: Mechanical tests on contacts and terminations - Test 16d: Tensile strength (crimped connections)*

IEC 60512-16-7*, Connectors for electronic equipment - Tests and measurements - Part 16-7: Mechanical tests on contacts and terminations - Test 16g: Measurement of contact deformation after crimping*

IEC 60721-3-1, *Classification of environmental conditions - Part 3-1: Classification of groups of environmental parameters and their severities – Storage*

IEC 60947-1:2020*, Low-voltage switchgear and controlgear - Part 1: General rules*

IEC 60999-1, *Connecting devices - Electrical copper conductors - Safety requirements for screw-type and screwless-type clamping units - Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers*

ISO 6892-1, *Metallic materials - Tensile testing - Part 1: Method of test at room temperature*

ISO 10447, *Resistance welding - Testing of welds - Peel and chisel testing of resistance spot and projection welds*

3 Terms and definitions

For the purpose of this document, the terms and definitions of IEC 60050-581, IEC 60512-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1

ultrasonic welding

process, in which the mechanical oscillations of a small amplitude and frequency of ultrasonic range, together with static pressure, enable the junction of materials at a much lower temperature than the melting point.

[SOURCE: IEV 841-33-03]

3.2

ultrasonic welding machine - ultrasonic welding system

system for ultrasonic welding consists of an ultrasonic generator, an ultrasonic converter, a sonotrode and the necessary electrical and mechanical accessories to operate it.
Note1 to entry – Figure 1 shows the construction of an ultrasonic welding system specifically designed for splicing wire. An ultrasonic welding machine is a device designed with specialized technology that can join together at least two wires. The process of joining the wires together is known as "splicing", and this machine makes the process much easier and more efficient than any manual method.

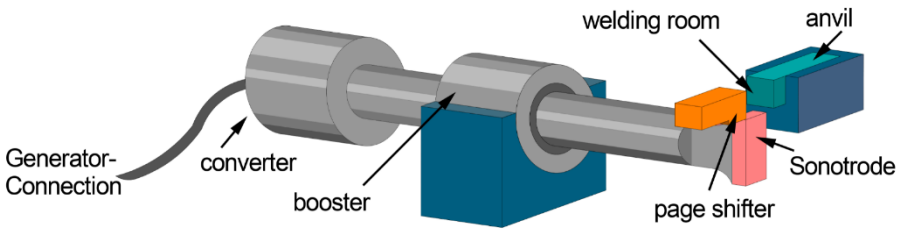

Figure 1 – Ultrasonic welding machine designed to make splices between at least two wires

3.3

ultrasonic generator

source that generates high frequency electrical energy to the ultrasonic transducers

3.4

ultrasonic converter

a ultrasonic converter is a device that takes electrical energy at an ultrasonic frequency and converts it into mechanical oscillations or vibrations.

3.5

sonotrode

the component that transmits ultrasonic vibrations directly to the parts to be welded.

3.6

vibration booster

intermediate member between the converter and the sonotrode, amplifying the ultrasonic oscillations.

3.7

surface or anvil plate

only Splice welding machines are equipped with a passive wall located below or to the side of the anvil and separated from the sonotrode by a defined gap to prevent contact and any possible damage to tools.

3.8

ultrasonic side slider

the ultrasonic side slider is a device used to adjust the welding width.

Note 1 to entry: The ultrasonic side slider is a device used to control the width of welding and can be positioned either over the sonotrode or above the anvil depending on the type of ultrasonic welding machine.

3.9

anvil

the anvil is a component of the ultrasonic welding machine, located on the opposite side of the horn and forming one wall of the welding room.

3.10

ultrasonic welding room

the ultrasonic welding room is an application specific area designed for inserting the materials and components that need to be welded together.

3.11

ultrasonically welded splice length

system-specific area of the sonotrode, which define the length of the weld package.

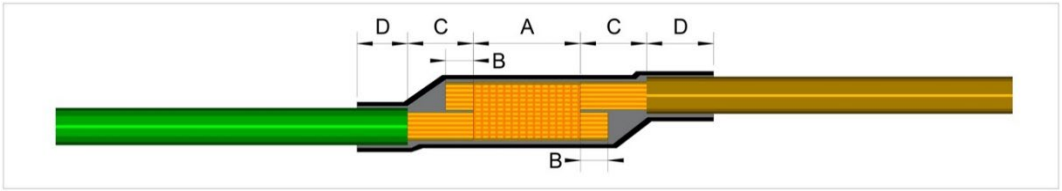

Figure 2 – Ultrasonically welded splice of two wires protected by a shrink tube

Note 1 to entry: Figure 2 provides a visual for an ultrasonically welded splice of two wires protected by a shrinking tube. Caption A reveals the splice's length, with Caption B indicating wire overhang at the end of the splice. Caption C highlights the distance between insulation and splice, while Caption D shows the overlapping length of the shrinking tube and wire insulation.

3.12

ultrasonic weld width

the welding width is defined by the passive tools of the welding machine that form the welding room.

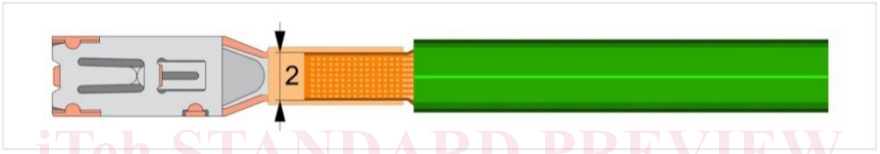

Figure 3 – Wire ultrasonically welded on a terminal

Note 1 to entry: Caption 2 in Figure 3 shows the weld width.

3.13

ultrasonic weld height

the height of the weld, in this document only the welded material (i.e., strands) is meant. Many application specifications will specify the welding height, along with the sheet thickness of the contact. This is because it's simpler to measure the welding height accurately by using either a calliper gauge or an outside micrometre. In order for both instruments to be up to the task, their discs should be larger than the distance between hills in order for accurate measurements to be taken.

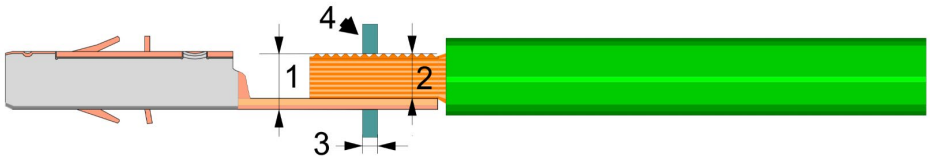

Figure 4 – Wire ultrasonically welded on a terminal

Note 1 to entry: Captions in Figure 4 shows (1) height including welding pad, (2) welding height, (3) measuring tool width, (4) measuring tool.

3.14

ultrasonically welded end compaction

a wire whose strands are welded together at one non-insulated end.