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

Connexions sans soudure – Partie 9: Connexions soudées par ultrasons – Exigences générales, méthodes d'essai et guide pratique

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IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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CONTENTS

FOREWORD.....	7
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	10
3 Terms and definitions	12
4 Wire and terminal information	16
4.1 Conductor materials.....	16
4.2 Conductor surface coating	16
5 Requirements for ultrasonic welding	16
5.1 Examples of ultrasonically welded connections.....	16
5.2 General requirements	19
5.3 Influence of wire length for welds at the other end of terminal connections	20
5.4 Design requirements.....	20
5.5 Mechanical and electrical protection of the weld package	22
5.6 Conductor combinations – requirements	23
5.7 Compaction ratio of ultrasonically welded connections	23
6 Specimens.....	25
6.1 General.....	25
6.2 Type A1 or A2 specimen	25
6.3 Type B1 or B2 specimen.....	25
6.4 Type C specimen	26
6.5 Type D specimen.....	27
7 Tests	27
7.1 General information about tests	27
7.1.1 General conditions for product qualification tests	27
7.1.2 Pre-conditioning	27
7.1.3 Recovery	27
7.2 Visual optical inspection (VOI) with dimensional checks.....	27
7.2.1 General	27
7.2.2 Magnification aids (visual optical inspection, VOI)	28
7.2.3 Visual inspection of the ultrasonic splice welding.....	28
7.2.4 Visual inspection of ultrasonically welded wire to terminal	29
7.3 Mechanical tests	31
7.3.1 Bending test inline splice	31
7.3.2 Bending test on ultrasonically welded wire to terminal	32
7.3.3 Peel test of the splice	32
7.3.4 Peel tests of the terminal-welded package.....	35
7.3.5 Pull-out force tests on ultrasonic splice-welded connections	36
7.3.6 Pull-out force tests of ultrasonically welded wire-to-terminal connections.....	38
7.3.7 Vibration test of ultrasonically welded splice connections	41
7.3.8 Vibration test of ultrasonically welded wire-to-terminal connections	42
7.3.9 Compaction force test of end splices	43
7.4 Microsection image inspections.....	44
7.5 Electrical tests	45
7.5.1 Voltage drop of the through or end splice (resistance)	45
7.5.2 Voltage drop of the wire-to-terminal connection (resistance).....	46

7.5.3	Current-carrying capacity.....	47
7.5.4	Insulation resistance.....	49
7.5.5	Voltage proof.....	49
8	Climatic tests.....	50
8.1	General information on climatic tests.....	50
8.2	Rapid change of temperature.....	50
8.3	Dry heat.....	51
8.4	Cold.....	51
8.5	Damp heat.....	51
8.6	Climatic sequence.....	52
8.7	Flowing mixed gas corrosion.....	52
9	Classification into product classes.....	53
9.1	General.....	53
9.2	Class A product.....	53
9.3	Class B product.....	53
9.4	Class C product.....	53
10	Test schedules.....	53
10.1	Test schedule A (class A products, see 9.2).....	53
10.2	Test schedule B (class B product, see 9.3).....	54
10.2.1	General.....	54
10.2.2	Mechanical tests of test schedule B.....	54
10.2.3	Electrical tests of test schedule B.....	55
10.2.4	Microsection tests of test schedule B.....	56
10.3	Test schedule C (class C products, see 9.4).....	56
10.3.1	General.....	56
10.3.2	Mechanical tests according to test schedule C.....	57
10.3.3	Electrical tests according to test schedule C.....	57
10.3.4	Microsection of test schedule C.....	58
10.3.5	Climatic test for test schedule C.....	58
11	Additional applicable test groups (if required).....	59
11.1	Dry heat test and voltage proof.....	59
11.2	Corrosion.....	59
12	Flow charts.....	60
Annex A	(informative) Practical guidance.....	64
A.1	Ultrasonic welding system.....	64
A.2	Storage conditions and processing conditions.....	64
A.3	Processing technique.....	65
A.3.1	General tooling technology requirements.....	65
A.3.2	Monitoring.....	65
Bibliography	66

Figure 1	– Ultrasonic welding machine designed to make splices between at least two wires.....	13
Figure 2	– Ultrasonically welded splice of two wires protected by a shrinking tube.....	14
Figure 3	– Top view of an ultrasonically welded wire on a terminal.....	14
Figure 4	– Side view of an ultrasonically welded wire on a terminal.....	15
Figure 5	– Ultrasonically welded end compaction.....	15

Figure 6 – Ultrasonically welded end splice connection.....	16
Figure 7 – Welding zone (1) for two stripped wires with heat shrink tubing (2) for insulation.....	17
Figure 8 – Ultrasonically welded end compaction.....	17
Figure 9 – Ultrasonically welded end splice.....	17
Figure 10 – Ultrasonically welded inline splice Cu-Al.....	17
Figure 11 – Ultrasonically welded inline splice Cu-Cu.....	17
Figure 12 – Example 1 of ultrasonic welding on terminals.....	18
Figure 13 – Example 2 of ultrasonic welding on terminals.....	18
Figure 14 – Example 3 of ultrasonic welding on terminals.....	18
Figure 15 – Example 4 of ultrasonic welding on terminals.....	18
Figure 16 – Example of multiple wires welded to one terminals.....	18
Figure 17 – Illustration of the conductor length (3) between terminal (2) and welded package (1).....	20
Figure 18 – Cross-sectional view of ultrasonic propagation through the sonotrode in the welding room, against passive surfaces with and without gap between the tools.....	20
Figure 19 – Cross-sectional view of recommended asymmetrical insertion for the individual conductors above the sonotrode in the welding room.....	21
Figure 20 – Cross-sectional alternative view of the recommended asymmetrical insertion for the individual conductors above the sonotrode.....	21
Figure 21 – Insulation measures at the inline splice from one conductor to several conductors.....	22
Figure 22 – Insulation measures at the feed-inline splice with several conductors on both sides.....	22
Figure 23 – Insulation measures at the end splice with several conductors (end sealed).....	23
Figure 24 – Cu-wire compaction ratio from strong to weak layout.....	24
Figure 25 – Conductor before and after welding.....	24
Figure 26 – Type A1 specimen.....	25
Figure 27 – Type A2 specimen.....	25
Figure 28 – Type B1 specimen, inline splice with two wires type 1 and type 2.....	26
Figure 29 – Type B2 specimen.....	26
Figure 30 – Type C specimen, end-splice connection with type 3 and type 4 wires.....	26
Figure 31 – Type D specimen at the wire to terminal connection.....	27
Figure 32 – Measurement of the ultrasonic weld height.....	30
Figure 33 – Measurement of the ultrasonic weld width (2).....	30
Figure 34 – Bending test setup schematic illustration.....	32
Figure 35 – Terminal bending test setup schematic illustration.....	32
Figure 36 – Test setup for peel tests.....	33
Figure 37 – Test setup for the peel test, fixation (4), side fixations with a protrusion of 1,0 mm each on the terminal surface, ultrasonically welded package (1), terminal (3).....	35
Figure 38 – Test setup for pull-out force test.....	36
Figure 39 – Test setup for the pull-out force test on welds with electrical conductors on terminal.....	39
Figure 40 – Test setup for vibration test of the splice.....	41
Figure 41 – Setup for vibration test of the ultrasonically welded package (1), vibration table (5), fixtures (2), terminal (4), reference wire with counter-contact connector (7).....	42

Figure 42 – Aluminium single wire end splice (wire end compacted)	43
Figure 44 – Medium copper single wire end splice (wire end compacted).....	43
Figure 45 – Large copper single wire end splice (wire end compacted)	43
Figure 46 – Examples of test clamps of different sizes	43
Figure 47 – Example 1 of a valid microsection image of ultrasonically welded copper strands	44
Figure 48 – Example 2 of a valid microsection image of ultrasonically welded copper strands	45
Figure 49 – Example 3 of a valid microsection image of ultrasonically welded copper strands	45
Figure 50 – Set-up for measurement at the splice (from 2 to 20 wires).....	45
Figure 51 – Measurements of reference wires type 1 and type 2	45
Figure 52 – Setup for voltage drop measurement (U_1), at the terminal weld connections	46
Figure 53 – Voltage drop measurement (U_2) with the same reference wire (1).....	47
Figure 54 – Setup for temperature rise measurements at current load	48
Figure 55 – Temperature chamber with valve opening for current-load measurements	49
Figure 56 – Diagram of dielectric voltage withstanding (voltage proof) test	50
Figure 57 – Test schedule A	60
Figure 58 – Test Schedule B	61
Figure 59 – Test schedule C part 1	62
Figure 60 – Test schedule C part 2	63
Figure A.1 – Ultrasonic welding process: 1) longitudinal, 2) torsional	64
Table 1 – Ultrasonically welded packages suggested values	22
Table 2 – Conductor combinations	23
Table 3 – Magnification suggestions for visual inspection	28
Table 4 – Example of good welds for end splices and inline splices	28
Table 5 – Representation of error characteristics for end splices and inline splices.....	29
Table 6 – Valid features of ultrasonically welded wire on terminal	30
Table 7 – Non-valid features of ultrasonically welded wire on terminal	31
Table 8 – Peel force values for ultrasonically welded splices of copper wires.....	33
Table 9 – Peel force values for ultrasonically welded splices of aluminium wires.....	34
Table 10 – Peel force values for ultrasonically welded copper wires on terminals	35
Table 11 – Peel force values for ultrasonically welded aluminium wires on terminals	36
Table 12 – Pull-out force values for ultrasonically welded splices of copper wires	37
Table 13 – Pull-out force values for ultrasonically welded splices of aluminium wires.....	38
Table 14 – Pull-out force values for ultrasonically welded copper wires on terminals	39
Table 15 – Dependence of package width on conductor cross-sectional area for copper wires (recommended)	40
Table 16 – Pull-out force values for ultrasonically welded aluminium wires on terminals	40
Table 17 – Dependence of package width on conductor cross-sectional area for aluminium wires (recommended).....	41
Table 18 – Vibration test (sinusoidal) parameters of ultrasonically welded splice connections	42

Table 19 – Requirements for single end compaction test	44
Table 20 – Test voltages for voltage proof test.....	50
Table 21 – Test group P0 – Initial inspection.....	53
Table 22 – Test group P1 – Bending test	54
Table 23 – Test group P2 – Peel test according to ISO 10447.....	55
Table 24 – Test group P3 – Pull-out force test	55
Table 25 – Test group P4 – Compaction-force for single wire end-splices	55
Table 26 – Test group P6 – Voltage drop (resistance).....	55
Table 27 – Test group P7 – Insulation resistance	55
Table 28 – Test group P10 – Microsection	56
Table 29 – Test group P0 – Initial inspection.....	56
Table 30 – Test group P2 – Peel tests	57
Table 31 – Test group P3 – Pull-out force tests.....	57
Table 32 – Test group P4 – Compaction-force test for single wire end-splices	57
Table 33 – Test group P5 – Vibration test (sinusoidal)	57
Table 34 – Test group P6 – Voltage drop (resistance).....	57
Table 35 – Test group P7 – Insulation resistance	58
Table 36 – Test group P8 – Current-carrying capacity.....	58
Table 37 – Test group P10 – Microsection	58
Table 38 – Test group P11 – Climatic tests	58
Table 39 – Test group P9 – Voltage proof.....	59
Table 40 – Test group P12 – Corrosion.....	59

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SOLDERLESS CONNECTIONS –**Part 9: Ultrasonically welded connections –
General requirements, test methods and practical guidance****FOREWORD**

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INTRODUCTION

This part of IEC 60352 covers ultrasonically welded connections and includes requirements, tests and practical guidance information.

Ultrasonic welding is a form of cold friction welding that is becoming increasingly popular in many industries. This type of welding uses ultrasonic vibration to join materials together, creating a bond that is both strong and reliable. Ultrasonic welding has been identified as a process in 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 cost. 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.

Three test schedules – A (basic), B (intermediate) and C (full) - are provided, based on a specific selection of test groups, each representing the minimum requirements for each correspondingly identified end-product class.

SOLDERLESS CONNECTIONS –

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

1 Scope

This part of IEC 60352 covers ultrasonically welded connections and includes requirements, tests and practical guidance information.

This document covers ultrasonically welded connections made with stranded or flexible wires (class 2, 5 or 6 per IEC 60228) of copper or copper alloy, as well as of aluminium or aluminium alloy.

These welded metal-to-metal connections shall employ wires with cross-sectional area of 0,08 mm² to 160 mm² and shall not exceed a total cross-sectional area, in case of wire bundle, of 200 mm².

For aluminium or aluminium alloy wires, 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 specified by the termination manufacturer.

NOTE Figures in this document show examples of possible solutions of ultrasonically welded connections of rectangular shape, but solutions are not restricted to the shape displayed.

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.

IEC 60050-581, *International Electrotechnical Vocabulary (IEV) – Part 581 – Electromechanical components for electronic equipment*

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-60, *Environmental testing – Part 2-60: Tests – Test Ke: Flowing mixed gas corrosion test*

IEC 60228, *Conductors of insulated cables*

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 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)*

IEC 61191-1:2018, *Printed board assemblies – Part 1: Generic specification – Requirements for soldered electrical and electronic assemblies using surface mount and related assembly technologies*

ISO 1463:2021, *Metallic and oxide coatings – Measurement of coating thickness –*

Microscopical method

ISO 6722-1, *Road vehicles – 60 V and 600 V single-core cables – Part 1: Dimensions, test methods and requirements for copper conductor cables*

ISO 6722-2, *Road vehicles – 60 V and 600 V single-core cables – Part 2: Dimensions, test methods and requirements for aluminium conductor cables*

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

ISO 21747:2006, *Statistical methods – Process performance and capability statistics for measured quality characteristics*

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 terminology databases for use in standardization at the following addresses:

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

3.1

ultrasonic welding

welding with pressure in which mechanical vibrations of high frequencies and of low amplitude, superimposed on a static force, make a weld between the two workpieces to be joined at a temperature well below the melting point of the material

[SOURCE: ISO /TR 25901-3:2016, 2.2.1.6.1]