



SLOVENSKI STANDARD
oSIST prEN ISO 14555:2017
01-januar-2017

Varjenje - Obločno varjenje čepov iz kovinskih materialov (ISO/FDIS 14555:2016)

Welding - Arc stud welding of metallic materials (ISO/FDIS 14555:2016)

Schweißen - Lichtbogenbolzenschweißen von metallischen Werkstoffen (ISO/FDIS 14555:2016)

Soudage - Soudage à l'arc des goujons sur les matériaux métalliques (ISO/FDIS 14555:2016)

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Welding — Arc stud welding of metallic materials

Soudage — Soudage à l'arc des goujons sur les matériaux métalliques

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Quality management in the field of welding*.

This fourth edition cancels and replaces the third edition (ISO 14555:2014), of which it constitutes a minor revision. The main changes are:

- a) undated reference to ISO 14732, ISO 13918 and ISO 15607;
- b) the expression “welding diameter” has been changed to “welding cross-section” in [3.6](#);
- c) the word “deformability” has been changed to “deformation” in the last sentence of [12.3](#);
- d) the second and third paragraphs have been combined to one paragraph in [12.4](#);
- e) the expression “welding diameter” has been changed to “visible width of the welding zone” in [12.6](#);
- f) the appearance “Collar off centre with unacceptable undercut” has now been given under “Visual examination or macro cut” in [Table A.6](#);
- g) the missing symbol “≤” in [Annex D](#) has been introduced for application ≤100.

Requests for official interpretations of any aspect of this document should be directed to the Secretariat of ISO/TC 44/SC 10 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

Introduction

The purpose of arc stud welding is to weld predominantly pin-shaped metal parts to metal workpieces. In this document, it is referred to simply as stud welding. Among other things, stud welding is used in bridge building (especially in composite structures), steel structures, shipbuilding, facade-wall fabrication, vehicle manufacture, equipment design, steam-boiler construction, and the manufacture of household appliances.

The quality of a stud weld depends not only on strict compliance with the welding procedure specification but also on the correct function of the actuating mechanism (e.g. welding guns), and on the condition of the components, of the accessories and of the power supply.

This document does not invalidate former specifications, providing the technical requirements are equivalent and satisfied.

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Welding — Arc stud welding of metallic materials

1 Scope

This document covers arc stud welding of metallic materials subject to static and fatigue loading. It specifies requirements that are particular to stud welding, in relation to welding knowledge, quality requirements, welding procedure specification, welding procedure qualification, qualification testing of operators and testing of production welds.

This document is appropriate where it is necessary to demonstrate the capability of a manufacturer to produce welded construction of a specified quality.

NOTE General quality requirements for fusion welding of metallic materials are given in ISO 3834-1, ISO 3834-2, ISO 3834-3, ISO 3834-4 and ISO 3834-5.

This document has been prepared in a comprehensive manner, with a view to it being used as a reference in contracts. The requirements contained within it can be adopted in full, or partially, if certain requirements are not relevant to a particular construction (see [Annex B](#)). For processing of stud welding, see [Annex A](#).

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 3834-2, *Quality requirements for fusion welding of metallic materials — Part 2: Comprehensive quality requirements*

ISO 3834-3, *Quality requirements for fusion welding of metallic materials — Part 3: Standard quality requirements*

ISO 3834-4, *Quality requirements for fusion welding of metallic materials — Part 4: Elementary quality requirements*

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

ISO 6947, *Welding and allied processes — Welding positions*

ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels*

ISO 9606-2, *Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys*

ISO 13918:2008, *Welding — Studs and ceramic ferrules for arc stud welding*

ISO 14175, *Welding consumables — Gases and gas mixtures for fusion welding and allied processes*

ISO 14731, *Welding coordination — Tasks and responsibilities*

ISO 14732, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials*

ISO/TR 15608, *Welding — Guidelines for a metallic materials grouping system*

ISO 15611, *Specification and qualification of welding procedures for metallic materials — Qualification based on previous welding experience*

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ISO 15613, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test*

ISO 17636 (all parts), *Non-destructive testing of welds — Radiographic testing*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3834-1, ISO 4063, ISO 14731, ISO 14732, ISO 15607 and ISO/TR 25901-3 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

stud

fastener to be attached by stud welding

3.2

auxiliaries

ceramic ferrules and shielding gases

3.3

stud-welding operator

operating personnel for stud-welding equipment

Note 1 to entry: In special cases (e.g. mass production at the manufacturer's factory), the welding can be carried out by suitable auxiliary personnel, appropriately trained and supervised.

3.4

stud diameter

d

stud (3.1) nominal diameter

Note 1 to entry: See ISO 13918.

3.5

welding diameter

d_w

diameter at the weld base

3.6

weld zone

welded area underneath the welded cross-section

3.7

current intensity

root-mean-square (RMS) value of the welding current in the steady state during the burning time of the arc

Note 1 to entry: Current intensity is not applicable to capacitor discharge.

3.8

welding time

time difference between the ignition and the final extinction of the main arc

3.9**lift***L*

distance between the stud tip and the work piece surface with the stud-lifting mechanism in position and activated

Note 1 to entry: For tip ignition, this definition applies to the ignition gap.

Note 2 to entry: See [Figure A.1](#).

3.10**plunge**

axial movement of the *stud* ([3.1](#)) towards the surface of the work piece

3.11**protrusion***P*

<unregulated lifting mechanism> distance between the tip of the *stud* ([3.1](#)) and the face of the support device in their initial positions, where the support device faces the work piece

Note 1 to entry: A spring-loaded lifting mechanism is an unregulated lifting mechanism.

Note 2 to entry: See [Figure A.1](#).

3.12**arc blow**

magnetic deflection of the arc from the axial direction of the *stud* ([3.1](#))

3.13**flux**

aluminium additive on the weld end of the *stud* ([3.1](#)), which improves the ignition and de-oxidizes the weld pool

3.14**dual-material stud**

two-material *stud* ([3.1](#)) composed of a material at the weld tip, similar to that of the parent material, and a dissimilar material outside the weld tip, which are joined by a friction weld, thus avoiding a mixed structure in the *weld zone* ([3.6](#)) when stud welding

3.15**structure subjected to fatigue loading**

structure subject to a set of typical load events described by the positions or movements of loads, their variation in intensity and their frequency and sequence of occurrence

3.16**through-deck stud-welding**

application where shear connectors are welded to a steel structure through thin steel sheet with a thickness of less than 3 mm

4 Symbols and abbreviated terms**4.1 Symbols**

For the purposes of this document, the following symbols apply.

ISO/FDIS 14555:2016(E)

C	capacitance (expressed in mF)
d	stud diameter (expressed in mm)
d_w	welding diameter (expressed in mm)
h	length of the threaded part of the nut
I	current intensity (expressed in A)
L	lift
P	protrusion
t	thickness of plate
t_w	welding time (expressed in ms or s)
T	torque (expressed in Nm)
U	charging voltage (expressed in V)
E	charging energy (expressed in Ws)
α	bending angle (expressed in °)

4.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

CF	ceramic ferrule
HAZ	heat-affected zone
NP	no protection
PA	flat welding position
PC	horizontal welding position
PE	overhead welding position
pWPS	preliminary welding procedure specification
SG	shielding gas
WPS	welding procedure specification
WPQR	welding procedure qualification record

5 Technical review

When a technical review is required by an application standard, by specification or by use of ISO 3834-2, ISO 3834-3 or ISO 3834-4, the manufacturer shall check, as appropriate, the following aspects:

- the accessibility and welding position of the stud weld;
- the nature of the surface and the collar shape of the welded joint;
- materials and combinations of materials (see [Tables A.3](#) and [A.4](#)); including decking material where the through-deck technique is being proposed;

- d) the ratio of stud diameter to parent metal thickness (avoidance of damage on the reverse side of the parent metal);
- e) dimensions and details of the weld preparation and of the finished weld, including the nature of the stud and parent-metal surfaces, positional and angular accuracy and the length tolerance of the welded stud;
- f) the use of special techniques to avoid damage to the reverse side of the parent metal;
- g) techniques to assure the angular position of the welded stud.

NOTE Consideration is paid to the multi-axial stress state arising from localized heating/cooling. This stress concentration reduces the fatigue strength of a component with welded studs.

6 Welding personnel

6.1 Stud-welding operators

The qualification can be done by a welding procedure test (see [10.2](#)) or a pre-production test (see [10.3](#)) and shall include testing in accordance with the acceptance criteria specified in [Clause 12](#), if relevant.

Stud-welding operators shall have appropriate knowledge to operate the equipment, to adjust it properly, to carry out the welding correctly and, while doing so, to pay attention to good contact and suitable connection between the work piece cables and uniform distribution of ferromagnetic materials (see [Table A.8](#)).

The welding personnel shall be qualified in accordance with ISO 14732.

The qualified operator shall be deemed to be qualified for any stud-welding equipment with the same mode of selecting the parameters which was used in the qualification test. Change in the welding process variant (numbers 783, 784, 785, 786 of ISO 4063) requires a new qualification.

A test of job knowledge is required for all qualification methods. This test shall cover, as a minimum:

- a) setting up the welding equipment in accordance with the welding procedure specification;
- b) basic knowledge of the way in which suitable connection of work piece cables, the polarity of the stud, and arc blowing can influence the weld result (see [Table A.8](#));
- c) basic assessment of the welded joint for imperfections (see [Tables A.5](#), [A.6](#) and [A.7](#));
- d) safe execution of the welding operations, i.e. good contact of the stud in the stud holder, no movement during the welding process, operation checking and correct positioning of the welding gun).

6.2 Welding coordination

Welding coordination shall be performed in accordance with ISO 14731. Refer to [Annex B](#) for quality level according ISO 3834-2, ISO 3834-3 and ISO 3834-4 for the welding coordinator.

Welding coordination personnel for stud welding shall have knowledge of and experience in the relevant stud-welding process, and shall be able to select and set the correct parameters, e.g. lift, protrusion (plunge), current intensity, and welding time.

A welding coordinator is not required for stud welding to structures subjected to unspecified static loading (see [Annex B](#)).