SLOVENSKI STANDARD
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Friction stir spot welding - Aluminium - Part 4: Specification and qualification of welding procedures (ISO 18785-4:2018)

Rührreibpunktschweißen - Aluminium - Teil 4: Festlegung und Qualifizierung des Schweißverfahrens (ISO 18785-4:2018)

Soudage par friction-malaxage par points - Aluminium - Partie 4: Descriptif et qualification des modes opératoires de soudage (ISO 18785-4:2018)

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Friction stir spot welding — Aluminium —

Part 4: Specification and qualification of welding procedures

Soudage par friction-malaxage par points — Aluminium —

Partie 4: Descriptif et qualification des modes opératoires de soudage

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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 of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

This document was prepared by the IIW, *International Institute of Welding*, Commission III, *Resistance welding, solid state welding and allied joining processes*.

Any feedback, question or request for official interpretation related to any aspect of this document should be directed to IIW via your national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

A list of all parts in the ISO 18785 series can be found on the ISO website.

Introduction

Welding processes are widely used in the fabrication of engineered structures. During the second half of the twentieth century, fusion welding processes, wherein fusion is obtained by the melting of parent material and usually a filler metal, dominated the welding of large structures. In 1991, friction stir welding (FSW), which is carried out entirely in the solid phase (no melting), was invented.

Friction stir spot welding (FSSW) processes are spot-like variants of the FSW process. Unlike FSW, there is minimal or no traverse motion of the tool. In basic FSSW, the joint is created by plunging a rotating tool into the work piece and retracting the tool out of the overlapping sheets. Other FSSW variants include additional tool movements. Frictional heat is generated from the contact between the tool and the material to be welded resulting in softening of this material. The softened material is stirred to form a metallurgical connection which is aided by the forge action applied by the tool shoulder contacting the upper sheet surface.

The increasing use of FSSW has created the need for a FSSW standard in order to ensure that welding is carried out in the most effective way and that appropriate control is exercised over all aspects of the operation. The ISO 18785 series focuses on the FSSW of aluminium because, at the time this document was developed, the majority of commercial applications for FSW involved aluminium. Examples include railway cars, consumer products, food processing equipment, automotive components, aerospace structures, and marine vessels.

To be effective, welded structures should be free from serious problems in production and in service. To achieve that goal, it is necessary to provide controls from the design phase through material selection, fabrication, and inspection. For example, poor design can create serious and costly difficulties in the workshop, on site, or in service. Incorrect material selection can result in welding problems such as cracking. Welding procedures need to be correctly formulated and approved to avoid imperfections. To ensure the fabrication of a quality product, management needs to understand the sources of potential trouble and introduce appropriate quality and inspection procedures, and supervision should be implemented to ensure that the specified quality is achieved.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning friction stir welding given in Clauses 5 to 7.

ISO takes no position concerning the evidence, validity and scope of this patent right. The holders of this patent right have assured ISO that they are willing to negotiate licenses under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. Further information may be obtained from:

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Friction stir spot welding — Aluminium —

Part 4: Specification and qualification of welding procedures

1 Scope

This document specifies the requirements for the content of welding procedure specifications for the Friction Stir Spot welding (FSSW) of aluminium.

In this document, the term "aluminium" refers to aluminium and its alloys

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

ISO 14270, *Resistance welding — Destructive testing of welds — Specimen dimensions and procedure for mechanized peel testing resistance spot, seam and embossed projection welds*

ISO 14271, *Resistance welding — Vickers hardness testing (low-force and microhardness) of resistance spot, projection, and seam welds*

ISO 14272, *Resistance welding — Destructive testing of welds — Specimen dimensions and procedure for cross tension testing of resistance spot and embossed projection welds*

ISO 14273, *Resistance welding — Destructive testing of welds — Specimen dimensions and procedure for tensile shear testing resistance spot and embossed projection welds*

ISO 17653, *Resistance welding — Destructive tests on welds in metallic materials — Torsion test of resistance spot welds*

ISO 18785-1, *Friction stir spot welding — Aluminium — Part 1: Vocabulary*

ISO 18785-5, *Friction stir spot welding — Aluminium — Part 5: Quality and inspection requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18785-1 apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Development and qualification of welding procedures

4.1 General

Qualification of welding procedures shall be performed prior to production welding.

The manufacturer shall prepare a preliminary welding procedure specification (pWPS) and shall ensure that it is applicable for production using experience from previous production jobs and/or the general fund of knowledge of welding technology.

A pWPS shall be used as the basis for the establishment of a welding procedure qualification record (WPQR). The pWPS shall be tested in accordance with one of the methods listed in Clause 5 (welding procedure test), or Clause 7 (pre-production welding test). Clause 5 shall be used when the production part or joint geometry is accurately represented by a standardized test piece or pieces, as specified in 5.2. However, Clause 5 shall be used when the production part or joint geometry is not accurately represented by the standardized test pieces, as specified in 5.2. The information required in a pWPS is given in 4.2.

For some applications, it may be necessary to supplement or reduce the list. All relevant information shall be specified in the WPS.

Once a pWPS has been qualified, the manufacturer shall prepare a Welding Procedure Specification (WPS) covering a range of parent material thicknesses, including tolerances, as well as a range of aluminium alloys.

An example of a pWPS form is shown in Annex A.

4.2 Technical content of a pWPS

The following information, as a minimum, shall be included in a pWPS.

4.2.1 Manufacturer information

— identification of manufacturer;

— identification of pWPS.

4.2.2 Composition of parent material

— designation of the material(s) and reference standard(s);

— when coatings are applied the following may include: type, thickness, number of faces, control document.

4.2.3 Dimensions of material

— thickness of materials comprising the welded joint.

4.2.4 Welding method

Process parameters are unique to each process variant (see corresponding annexes for details).

— basic (includes probe-less) FSSW (see Annex A);

— refill FSSW (see Annex A and Annex B);

— swing FSSW (see Annex A and Annex B);

— swept FSSW (see Annex A and Annex B);

— stitch FSSW (see Annex A and Annex B).

4.2.5 Machine specifications

— type or model;

— manufacturer;

— auxiliary equipment.

4.2.6 Tool identification

— material;

— drawing or drawing number or identification number.

4.2.7 Clamping processes and conditions

— method and type of jigging, fixtures, rollers and backing support (dimensions and material);

— tool and fixture heating/cooling (internal, external, cooling medium), if applicable;

— tacking arrangement.

4.2.8 Joint design

— overlap;

— edge distance;

— joint stack-up;

— sealant and/or adhesive (type, grade, location, dimension);

— tool plunge side.

NOTE A sketch of the welded joint can be used to show the joint design/configuration.

4.2.9 Joint preparation and cleaning methods

— cleaning procedure (degreasing, wire brushing, chemical etching, etc.);

— pre-weld heat treatment procedure, if applicable.

4.2.10 Welding technique

— mechanized, automatic welding;

— procedures to minimize distortion, indentation, contamination, corrosion, etc.

Operator protection shall be taken into consideration.

4.2.11 Post-weld processing

— stress relieving (or other methods to correct distortion);

— removal of flash, or any other mechanical post weld processing of the weldment;

— post-weld heat-treatment (temperature range and minimum time for post-weld heat treatment or ageing shall be specified or reference shall be made to other standards which specify this information).