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Friction stir spot welding — Aluminium —

Part 1: Vocabulary

Soudage par friction-malaxage par points — Aluminium —

Partie 1: Vocabulaire

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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 the IIW, *International Institute of Welding*, Commission III, *Resistance welding, solid state welding and allied joining*.

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.

Friction stir spot welding — Aluminium —

Part 1: Vocabulary

1 Scope

This document defines friction stir spot welding (FSSW) process terms and definitions.

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 25239-1, *Friction stir welding — Aluminium — Part 1: Vocabulary*

ISO/TR 25901-1, *Welding and Allied Processes — Vocabulary — Part 1: General terms*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 25239-1, ISO/TR 25901-1, ISO 14732, and the following 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/

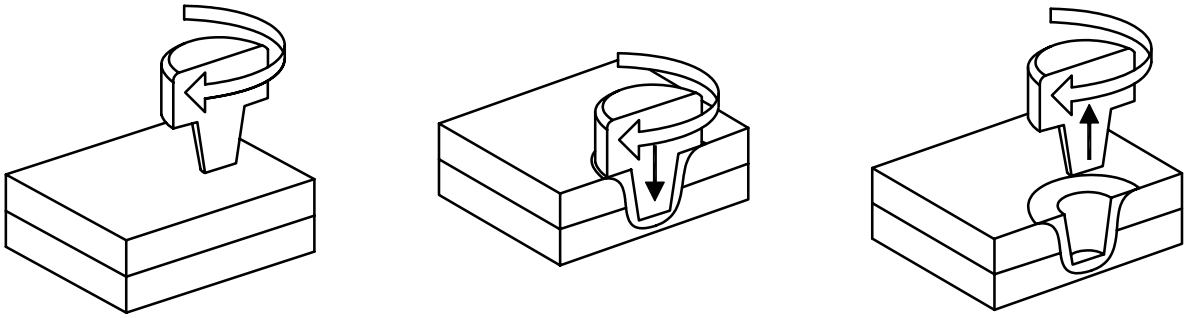
3.1
friction stir spot welding
FSSW
friction stir welding process producing a small aspect ratio, discrete lap weld by frictional heating and mixing of material in the plastic state caused by the plunge and retraction of a rotating *probe* (3.2), with or without traverse movement

Note 1 to entry: See Figure 1.

3.2
probe
<FSSW> part of the tool extending into the parent material to make the weld

Note 1 to entry: The probe can be either fixed or adjustable.

Note 2 to entry: When a probe is not present, the process is known as “probe-less” FSSW.



a) Rotation b) Plunge c) Retract

Figure 1 — Basic principle of friction stir spot welding

3.3
shoulder
<FSSW> portion of the tool that contacts the parent material surface during welding

3.4
rotation speed
<FSSW> speed of spindle rotation

3.5
rotation direction
<FSSW> direction of spindle rotation

3.6
plunge speed
<FSSW> speed at which the *probe* (3.2) penetrates the work piece during the plunging phase of *FSSW* (3.1)

3.7
plunge depth
<FSSW> distance the *probe* (3.2) extends into the work piece

3.8
force control
<FSSW> method to maintain the required force on the tool during welding

3.9
position control
<FSSW> method to maintain the required position of the tool during welding

3.10
dwell time
<FSSW> time interval between when the rotating tool reaches its maximum depth in the parent material and the start of tool retraction

3.11
exit hole
<FSSW> hole remaining at the end of a weld after the withdrawal of the tool

3.12
faying surface
surface of one component that is intended to be in contact with, or in close proximity to, a surface of another component to form a joint

3.13
weld setter
<FSSW> person who sets up *FSSW* (3.1) welding equipment

Note 1 to entry: Does not apply to *welding operators* (3.14) and/or personnel loading/unloading of the *automatic welding* (3.15) unit.

Note 2 to entry: FSSW is an automatic welding process where adjustment of welding variables is not possible during the short welding cycle.

3.14
welding operator
<FSSW> person who operates *FSSW* (3.1) welding equipment

3.15
automatic welding
welding in which all operations are performed without manual intervention during the welding cycle

3.16
set-up
<FSSW welding unit> approved configuration of the welding unit and the work pieces before welding and, if required, modifications to the operating program

3.17
basic FSSW
friction stir spot welding (3.1) where the weld is produced by the plunge and retract of a rotating *probe* (3.2) without traverse movement

Note 1 to entry: 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 (see Figure 1).

3.18
refill FSSW
basic FSSW (3.17) followed by a refill action resulting in no *exit hole* (3.11)

Note 1 to entry: See Figure 2 and Figure 3.

3.18.1
refill FSSW tool
tool composed of a *clamping ring* (3.18.3), an *adjustable shoulder* (3.18.2) which is able to move axially and an adjustable *probe* (3.2)

3.18.2
adjustable shoulder
<refill FSSW> part of the tool that is coaxial to the adjustable *probe* (3.2) and able to rotate and move axially independent of the adjustable probe and the *clamping ring* (3.18.3)

3.18.3
clamping ring
<refill FSSW> non-rotating ring that forms the outer portion of the tool that serves to clamp the work piece components during spot welding

Note 1 to entry: The clamping ring may also serve to contain material to prevent expulsion from the *FSSW* (3.1).

3.18.4
clamping ring force
<refill FSSW> force applied by the *clamping ring* (3.18.3) to the work piece along the axis of the tool