



**Specification
for Friction Stir
Welding of
Aluminum
Alloys for
Aerospace
Applications**



American Welding Society



**AWS D17.3/D17.3M:2010
An American National Standard**

**Approved by the
American National Standards Institute
July 1, 2009**

**Specification for
Friction Stir Welding of
Aluminum Alloys for
Aerospace Applications**

1st Edition

Prepared by the
American Welding Society (AWS) D17 Committee on Welding in
the Aircraft and Aerospace Industries

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This specification covers the general requirements for the friction stir welding of aluminum alloys for aerospace applications. It includes the requirements for weldment design, qualification of personnel and procedures, fabrication, and inspection.



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Foreword

This foreword is not part of AWS D17.3/D17.3M:2010, *Specification for Friction Stir Welding of Aluminum Alloys for Aerospace Applications*, but is included for informational purposes only.

In the fall of 1993, aerospace welding personnel gathered together under the auspices of the American Welding Society (AWS) to develop an aerospace fusion welding specification to replace MIL-STD-1595A, *Qualification of Aircraft, Missile, and Aerospace Fusion Welders*, and MIL-STD-2219, *Fusion Welding for Aerospace Applications*. The result of this initial meeting was the formation of the AWS D17 Committee on Welding in the Aircraft and Aerospace Industries. The overriding theme voiced by the committee members was that the aviation industry had changed and a new specification was needed. In 2001, after years of hard work by the committee members, the American Welding Society issued AWS D17.1:2001, *Specification for Fusion Welding for Aerospace Applications*.

Specifications used for aerospace welding deal primarily with fusion welding, except for the relatively few that deal with friction welding. Fusion welding is used to produce the vast majority of large, structural, welded components, as opposed to friction welding, which usually is used to join smaller, circular cross-section detail parts. In 1991, The Welding Institute, in England, patented a new welding process called Friction Stir Welding (FSW). The question soon arose as to which requirements were necessary to specify and control this new welding process. Fusion welding specifications could not adequately address FSW because it is a solid-state welding process. Friction welding specifications also could not adequately address FSW process because unlike friction welding, FSW process uses a third body, the welding tool.

The AWS D17 Committee on Welding in the Aircraft and Aerospace Industries determined that it was necessary to form a subcommittee to write a specification for friction stir welding. It was appropriate that the setting for the subcommittee's kickoff meeting was at the Kennedy Space Center in Florida. Kennedy Space Center is where the first friction stir welded commercial aerospace component, the fuel tank for the Delta launch vehicle, went into service. Representatives from industry, welding institutes, government agencies and universities met to dedicate themselves to form a specification for the friction stir welding of aluminum for aerospace applications. AWS D17.1:2001, *Specification for Fusion Welding for Aerospace Applications* served as the model for this specification.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary AWS D17 Committee on Welding in the Aircraft and Aerospace Industries, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

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Table of Contents

| | Page No. |
|---|-----------------|
| <i>Personnel</i> | v |
| <i>Foreword</i> | vii |
| <i>List of Tables</i> | xi |
| <i>List of Figures</i> | xi |
| 1. Scope | 1 |
| 1.1 Units of Measure | 1 |
| 1.2 Health and Safety | 1 |
| 2. Normative References | 1 |
| 3. Terms and Definitions | 2 |
| 4. General Requirements | 7 |
| 4.1 Classification | 7 |
| 4.2 Approval | 8 |
| 4.3 Drawing Precedence | 8 |
| 4.4 Specification Precedence | 8 |
| 5. Design of Weld Joints | 8 |
| 5.1 Weldment Design Data | 8 |
| 5.2 Drawing Information Requirements | 9 |
| 6. Development and Qualification of a Welding Procedure | 9 |
| 6.1 General | 9 |
| 6.2 Selection of a Welding Procedure Qualification Method | 10 |
| 6.3 Preparation of a Preliminary Welding Procedure Specification (pWPS) | 11 |
| 6.4 Welding | 12 |
| 6.5 Evaluation of Test Welds | 12 |
| 6.6 Welding Procedure Qualification Record (WPQR) | 13 |
| 6.7 Welding Procedure Qualification Variables | 14 |
| 6.8 Welding Procedure Specification (WPS) | 17 |
| 6.9 Revising a WPQR or WPS | 17 |
| 7. Welding Operator Qualification | 17 |
| 7.1 Qualification Requirements | 17 |
| 7.2 Qualification Limitations | 18 |
| 7.3 Qualification/Certification Validity | 20 |
| 7.4 Test Records | 20 |
| 8. Fabrication | 21 |
| 8.1 Welding Equipment Requirements | 21 |
| 8.2 Friction Stir Welding Tool | 21 |
| 8.3 Preweld Joint Preparation and Fit-Up | 21 |
| 8.4 Preheat Temperature Control | 21 |
| 8.5 Tack Welds | 21 |
| 8.6 Welding | 21 |
| 8.7 Postweld Surface Preparation | 21 |

| | | |
|-----------|--|-----------|
| 8.8 | Weld Identification Requirements | 21 |
| 8.9 | Acceptance Inspection | 22 |
| 9. | Inspection | 22 |
| 9.1 | General | 22 |
| 9.2 | Inspection Personnel | 22 |
| 9.3 | Visual Weld Inspection | 22 |
| 9.4 | Nondestructive Testing | 22 |
| 9.5 | Acceptance Criteria | 22 |
| | Annex A (Normative)—Illustrations of Test Specimens and Test Fixtures | 25 |
| | Annex B (Informative)—Example of a Welding Operator Qualification Test Record Form | 29 |
| | Annex C (Informative)—Examples of Welding Procedure Specification Forms | 31 |
| | Annex D (Informative)—Examples of Welding Procedure Qualification Record Forms | 33 |
| | Annex E (Informative)—Guidelines for the Preparation of Technical Inquiries | 39 |
| | List of AWS Documents on Welding in the Aircraft and Aerospace Industries | 41 |

List of Tables

| Table | | Page No. |
|-------|--|----------|
| 6.1 | Sequence for Qualifying a Welding Procedure Specification | 9 |
| 6.2 | Methods for Qualifying a Welding Procedure | 11 |
| 6.3 | Destructive Tests Required for Qualifying a Welding Procedure | 12 |
| 6.4 | Efficiency Requirements for Welded Butt Joint Tensile Strength | 17 |
| 9.1 | Acceptance Levels for Discontinuities | 23 |

List of Figures

| Figure | | Page No. |
|--------|---|----------|
| 3.1 | Friction Stir Welding Nomenclature | 2 |
| 3.2 | Angular Distortion of the Joint | 3 |
| 3.3 | Cavity | 3 |
| 3.4 | Flash | 4 |
| 3.5 | Heel and Heel Plunge Depth | 4 |
| 3.6 | Hook | 5 |
| 3.7 | Incomplete Joint Penetration | 5 |
| 3.8 | Linear Mismatch Across Joint | 6 |
| 3.9 | Tool Offset | 7 |
| 3.10 | Components of Tool | 8 |
| 6.1 | Flow Diagram for the Development and Qualification of a Welding Procedure | 10 |
| 6.2 | Location of Square Groove Weld Test Specimens—Pipe | 13 |
| 6.3 | Location of Square Groove Weld Test Specimens—Plate | 14 |
| 6.4 | Location of Fillet Weld Test Specimens—Plate | 15 |
| 6.5 | Location of Seam Weld Test Specimens—Plate | 16 |
| 7.1 | Seam Weld Test in Plate | 18 |
| 7.2 | Square Groove Weld Test in Pipe | 19 |
| 7.3 | Square Groove Weld Test in Plate | 19 |
| 7.4 | Seam Weld Test in Pipe | 20 |
| A.1 | Reduced Section Tension Specimen—Rectangular | 25 |
| A.2 | Reduced Section Tension Specimen—Round | 26 |
| A.3 | Alternate Tension Specimen for Pipe 3 in [76 mm] O.D. or Less | 26 |
| A.4 | Alternate Tension Specimen for Pipe 2 in [51 mm] O.D. or Less | 27 |
| B.1 | Example of a Welding Operator Qualification Test Record Form | 29 |
| C.1 | Example of a Preliminary Welding Procedure Specification Form | 31 |
| C.2 | Example of a Welding Procedure Specification Form | 32 |
| D.1 | Example Number One of a Welding Procedure Qualification Record Form | 33 |
| D.2 | Example Number Two of a Welding Procedure Qualification Record Form | 35 |

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Specification for Friction Stir Welding of Aluminum Alloys for Aerospace Applications

1. Scope

This specification contains the requirements for designing, friction stir welding, and inspecting aluminum aerospace hardware. Friction stir welding (FSW) produces a weld between two abutting workpieces by the friction heating and plastic material displacement caused by a rotating tool that traverses along the weld joint.

1.1 Units of Measure. This standard makes use of both U.S. Customary Units and the International System of Units (SI). The latter are shown within brackets [] or in appropriate columns in tables and figures. The measurements may not be the exact equivalents; therefore, each system shall be used independently. Consult AWS A1.1, *Metric Practice Guide for the Welding Industry*, for additional information.

1.2 Health and Safety. Safety and health issues and concerns are beyond the scope of this standard and therefore are not fully addressed herein. Safety and health information is available from other sources, including, but not limited to, ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, and applicable federal, state, and local regulations.

2. Normative References

The following standards contain provisions, which through reference in this AWS Standard constitute mandatory provisions of this AWS Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

AIA/NAS document:¹

NAS 410, *NAS Certification & Qualification of Nondestructive Test Personnel*.

ANSI document:²

ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*.

ASTM documents:³

ASTM B881-D5, *Standard Terminology Relating to Aluminum- and Magnesium-Alloy Products*

ASTM E 164, *Standard Practice for Ultrasonic Contact Examination of Weldments*;

ASTM E 1417, *Standard Practice for Liquid Penetrant Examination*;

ASTM E 1742, *Standard Practice for Radiographic Examination*.

AWS documents:⁴

AWS A1.1, *Metric Practice Guide for the Welding Industry*;

AWS A2.4, *Standard Symbols for Welding, Brazing and Nondestructive Examination*;

AWS A3.0, *Standard Welding Terms and Definitions*;

AWS B5.1, *Specification for the Qualification of Welding Inspectors*;

AWS QC1, *Standard for AWS Certification of Welding Inspectors*.

¹ AIA/NAS standards are published by the Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928.

² ANSI standards are published by the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.

³ ASTM standards are published by the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

⁴ AWS documents are published by the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.