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

Specification for Friction Stir Welding of Aluminum Alloys for Aerospace Applications

American Welding Society

Approved American National Standard
ANSI

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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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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.*

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[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.
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