

AWS D17.1/D17.1M:2017
An American National Standard



Specification for Fusion Welding for Aerospace Applications



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Specification for Fusion Welding for Aerospace Applications

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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 provides the general welding requirements for welding aircraft and space hardware. It includes but is not limited to the fusion welding of aluminum-based, nickel-based, iron-based, cobalt-based, magnesium-based, and titanium-based alloys using electric arc and high energy beam processes. There are requirements for welding design, personnel and procedure qualification, inspection, and acceptance criteria for aerospace, support, and non-flight hardware. Additional requirements cover repair welding of existing hardware. A commentary for the specification is included.



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Foreword

This foreword is not part of this standard but is included for informational purposes only.

Prior to 1977, aviation welding specifications were primarily dependent on government standards for contract purchases and were based on welding technology from the 1950s. Those specifications were MIL-W-8611 (steel), MIL-W-8604 (aluminum), MIL-W-18326 (magnesium), and MIL-T-5021 for welder performance requirements. In 1977, the aviation and aerospace industry and government moved to update some of these standards by consolidating the welder's performance of MIL-T-5021 into MIL-STD-1595. MIL-STD-1595 was issued as a supplement to the ASME Section IX code in 1977. It was subsequently revised and superseded by MIL-STD-1595A in 1983. The first update to the 1950's welding process specifications came with the release of MIL-W-8604A in 1982, almost 30 years after its initial release. The material welding specifications MIL-W-8604, MIL-W-8611, and MIL-W-18326 were consolidated into MIL-STD-2219 in 1988 and represented the most significant change to aviation welding standards in more than 30 years.

After two unsuccessful attempts to change the military standards, the American Welding Society contacted the industry and proposed a meeting to develop a national specification. Interested welding personnel from the aviation industry gathered together in the autumn of 1993 to lay the foundation for a national aviation and aerospace specification for fusion welding to replace MIL-STD-1595A and MIL-STD-2219. This meeting led to the formation of the AWS D17 Committee on Welding in the Aircraft and Aerospace Industries. The overriding theme the welding committee members brought to the table was that the aviation industry had changed. Those changes affected the welding processes and procedures, base metal and filler metal types, quality, and the inspection equipment, just to name a few. Since the 1950s, the welding specifications had not completely kept pace during the revision process to reflect those technology changes. The writing of this specification was a prime opportunity for the industry and government to create a document to include those changes. Through an industrial effort and committee consensus, this specification represents several years of work, bringing the aviation and aerospace industry together to acknowledge the technological advances of welding and materials. Included in this document is weld repair technology to enable the use of weld repair beyond those areas originally designated for a weld.

Changes to this third edition of D17.1 include the following:

- (1) Removed Annex B—Effective Throat of 2010 edition
- (2) Added Annex D—Materials in Table 5.4 with cross-referenced UNS numbers to [proprietary tradenames].
- (3) Added Annex G—Samples of Welding Forms for WPSs, PQRs, and Welder Performance Qualifications by removing the samples from elsewhere in the standard.
- (4) Added Annex H—Qualified Positions for Production Welding
- (5) Added Annex I—Common Acronyms Used in this Standard for quick user reference.
- (6) Added Figures 5.11C and 5.11D to the standard.
- (7) Separated Table B.3 into B.3 and B.3M, one for U.S. Customary Units and one for the International System of Units.
- (8) Conversion values were updated to reflect AWS A1.1, *Metric Practice Guide for the Welding Industry*.

Underlined areas in text indicate an addition and vertical lines adjacent to text, figures, tables, and equations indicate where changes (additions, modifications, corrections, deletions) from the 2010 edition were made.

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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. General Requirements	1
1.1 Scope	1
1.2 Units of Measure	1
1.3 Safety	1
1.4 Classification	2
1.5 Approval	2
1.6 Mandatory Provisions and Authority	2
2. Normative References	2
2.1 Government Documents	2
2.2 Nongovernment Documents	2
3. Terms and Definitions	3
4. Design of Welded Connections	4
4.1 Scope	4
4.2 Weldment Design Data	4
4.3 General Drawing Requirements	4
5. Welding Procedure and Performance Qualification	5
5.1 General	5
5.2 Welding Procedure Data and Qualification	5
5.3 Performance Qualification—General Requirements	13
5.4 Performance Qualification—Detailed Requirements	15
6. Fabrication	29
6.1 Scope	29
6.2 Welding Consumables	29
6.3 Welding Equipment	30
6.4 Weld Settings	30
6.5 Preweld Cleaning and Other Preparation	31
6.6 Preweld Joint Preparation and <u>Fitup</u>	31
6.7 Preheating and Interpass Temperature Control	32
6.8 Tack Welds	32
6.9 Weld Start and Run-Off Tabs	33
6.10 Weld Shielding for GTAW, GMAW, and PAW	33
6.11 Tungsten Electrodes	33
6.12 Filler Materials	33
6.13 Interpass Cleaning	34
6.14 Welding and Weldments	34
6.15 Postweld Cleaning	35
6.16 Postweld Processing	35
6.17 Weld Identification Requirements	35

6.18	Acceptance Inspection	35
6.19	Rework	35
6.20	Repair	36
7.	Inspection	36
7.1	Qualification of Inspection Personnel	36
7.2	Visual Weld Inspection	36
7.3	Nondestructive Examination	36
7.4	Acceptance Criteria	37
8.	Repair of Existing Structures	43
8.1	Scope	43
8.2	Design	43
8.3	Welding Procedures	43
8.4	Welder and Welding Operator Qualification	44
8.5	Welding Equipment	44
8.6	Weld Repair Inspection	44
8.7	Grounding and Bonding	44
8.8	Repair Documentation	44
9.	Nonflight Hardware	44
9.1	Scope	44
9.2	Exceptions and Additional Requirements	44
Annex A	(Normative) — Guidelines for Design, Analysis, and Fabrication of Weld Joints	51
Annex B	(Normative) — Bend Testing Criteria	65
Annex C	(Informative) — Informative References	73
Annex D	(Informative) — Cross referenced UNS numbers to [proprietary tradenames], ASTM, and AISI Designations	75
Annex E	(Informative) — Requesting an Official Interpretation on an AWS Standard	77
Annex F	(Informative) — Commentary	79
Annex G	(Informative) — Samples of Welding Forms for WPSs, PQRs, and Welder Performance Qualifications	89
Annex H	(Informative) — Qualified Positions for Production Welding	95
Annex I	(Informative) — Common Acronyms Used in this Standard	99

List of Tables

Table	Page No.
5.1	Welding Procedure Specification (WPS) Data 7
5.2	Procedure Qualification Variables 9
5.3	PQR Test Requirements 13
5.4	Base Metal Groups for Qualification of Welders, Tack Welders, and Welding Operators 18
5.5	Welding Position and Base Metal Form Qualified by Test Weld for Qualification of Welders, Tack Welders, and Welding Operators 19
5.6	Other Welding Conditions Qualified by Test for Qualification of Welders and Tack Welders 19
6.1	Gas Requirements 30
6.2	Recommended Shielding Gases for Welding 30
6.3	Preheat and Interpass Temperatures 32
6.4	Filler Metal Guidelines for Welding Aluminum Alloys Using GMAW, GTAW, and PAW Processes 33
6.5	Filler Metal Guidelines for Welding Titanium Alloys Using GMAW, GTAW, and PAW Processes 33
6.6	Filler Metal Guidelines for Welding Stainless Steels and Heat-Resistant Alloys Using GMAW, GTAW, and PAW Processes 34
7.1	Acceptance Criteria (in [mm]) 38
9.1	Industrial Codes and Specifications Suggested for Welding Aerospace Nonflight Hardware 45
A.1	Equivalent Fillet Weld Leg Size for Skewed T-Joints 64
B.1	Base Metals for Which Bend Testing is Not Applicable 66
B.2	Bend Specimen Thickness and Bend Radius (in) 67
B.2M	Bend Specimen Thickness and Bend Radius (mm) 68
B.3	Bend Specimens for Groove Welds in Tube (in) 69
B.3M	Bend Specimens for Groove Welds in Tube (mm) 70

List of Figures

Figure	Page No.
5.1	Groove Weld in Sheet: Positions 1G, 2G, 3G, and 4G 20
5.2	Fillet Weld in Sheet: Positions 1F, 2F, 3F, and 4F 21
5.3	Groove Weld in Tube: Positions 1G, 2G, 5G, and 6G 22
5.4	Fillet Weld in Tube: Positions 1F, 2F, 4F, and 5F 23
5.5	Groove Test Weld in Sheet 24
5.6	Fillet Test Weld in Sheet 25
5.7	Groove Test Weld in Tube 25
5.8	Fillet Test Weld in Tube 26
5.9	Blank Locations for Metallographic (M) Specimens in Fillet-Welded Sheet 26
5.10	Blank Locations for Metallographic (M) Specimens in Fillet-Welded Tube 27
5.11A	Complete Fusion at Root in Fillet Welds When Thickness of Both Members is Greater Than 0.063 in [1.60 mm] 27
5.11B	Incomplete Fusion at Root in Fillet Welds When Thickness of Any Member is Less Than or Equal to 0.063 in [1.60 mm] 28

5.11C	<u>Condition of Surfaces Opposite Lap and T-Joint Fillet Welds—Melt Through in Fillet Welds</u>	28
5.11D	<u>Condition of Surfaces Opposite Lap and T-Joint Fillet Welds—Unacceptable Melt Through in Fillet Welds</u>	29
6.1	Joint Preparation in Joint Members of Unequal Thickness	32
7.1	Acceptable and Unacceptable Weld Profiles	41
7.2	Mismatch Between Joint Members After Welding	42
A.1(a)	Square Groove Butt Joints	52
A.1(b)	Single-Bevel-Groove Weld Joints	53
A.1(c)	Single-V-Groove Weld Joints	54
A.1(d)	Single-J-Groove Weld Joints	55
A.1(e)	Single-U-Groove Weld Joints	56
A.1(f)	Double-Bevel-Groove Weld Joints	57
A.1(g)	Double-V-Groove Weld Joints	58
A.1(h)	Double-J-Groove Weld Joints	59
A.1(i)	Double-U-Groove Weld Joints	60
A.2	Two- and Three-Piece T-Weld Joints – Melt Through Welds	61
A.3(a)	Flanged Joints	61
A.3(b)	Flanged Edge Joints (Nonstandard)	62
A.4	Fillet Weld Details	63
B.1	Bend Specimens in Groove Welded Tube	71
G.1	<u>Example of a Welding Procedure Specification</u>	90
G.2	<u>Example of a Procedure Qualification Record</u>	91
G.3	<u>Example of a Performance Qualification Test Record</u>	93
H.1	<u>Positions of Production Groove Welds</u>	95
H.2	<u>Positions of Production Fillet Welds</u>	96
H.3	<u>Production Welding Position Diagram for Groove Welds in Pipe or Tube</u>	97

Specification for Fusion Welding for Aerospace Applications

1. General Requirements

1.1 Scope. This specification contains requirements for fusion welding and non-destructive examination (NDE) of aerospace flight hardware as well as for the welding and NDE of non-flight hardware. When this specification is stipulated in contract documents, conformance with all provisions of the specification shall be required, except for those provisions specifically exempted or modified by the Engineering Authority or contract documents.

The following is a summary of the specification clauses:

Clause 1. **General Requirements:** basic information on the scope and provisions of this specification.

Clause 2. **Normative References:** a listing of the documents that are required for the application of this specification.

Clause 3. **Terms and Definitions:** a list of technical terms and definitions of particular importance to this specification.

Clause 4. **Design of Welded Connections:** requirements and guidance information for the design of welded connections.

Clause 5. **Welding Procedure and Performance Qualification:** qualification requirements for welding procedures, welders, welding operators, and tack welders.

Clause 6. **Fabrication:** requirements for preparation, assembly, and workmanship when welding aerospace hardware.

Clause 7. **Inspection:** criteria for inspector qualification, responsibilities of inspectors, acceptance of production welds, and standard requirements for performing visual inspection and nondestructive examination (NDE).

Clause 8. **Repair of Existing Structures:** requirements for repair of existing aerospace flight hardware.

Clause 9. **Nonflight Hardware:** requirements for welding nonflight hardware.

1.1.1 Flight Hardware. The purpose of this specification is to provide requirements for commonly used fusion welding processes, materials, and acceptance criteria for production welds. This specification also provides requirements for materials, processes, and acceptance criteria that are not listed in this specification when approved by the Engineering Authority.

1.1.1.1 Aircraft, Rotorcraft, and Engines Subject to Federal Aviation Administration (FAA) Regulation. When applying welding in the design, construction, and repair of aircraft, rotorcraft, or engines subject to FAA regulation, the Engineering Authority must perform the appropriate design analyses and impose process control measures that will ensure compliance with the applicable requirements of the Code of Federal Regulations, Title 14.

1.1.2 Nonflight Hardware. Nonflight hardware, tooling, ground support equipment, and related nonconventional aerospace facilities shall be designed and welded in accordance with the requirements of Clause 9.

1.2 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 must be used independently.

1.3 Safety. Safety and health issues and concerns are beyond the scope of this standard and therefore are not addressed herein.