

AWS D17.1/D17.1M:2024
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, fabrication, inspection, and acceptance criteria for aerospace, support, non-flight hardware, and crewed spaceflight hardware. Additional requirements cover repair welding of existing hardware. A commentary for the specification is included.



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This revision of AWS D17.1/D17.1M, *Specification for Fusion Welding for Aerospace Applications*, is respectfully dedicated to the memory of Jagdish (JT) Amin, who served on the AWS D17 Committee on Welding in the Aircraft and Aerospace Industry since 1995.

The Committee sadly misses his passion, wisdom, and friendship. His commitment and significant contributions to the advancement of the aerospace industry will live on through this new revision.

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Personnel

AWS D17 Committee on Welding in the Aircraft and Aerospace Industries

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M. R. Lanouette	<i>The Boeing Company</i>
M. Ludmer	<i>Advanced Weldtec Inc.</i>
R. Maust, III	<i>RTX – Raytheon Missiles and Defense</i>
L. Morris	<i>RTX – Raytheon Missiles and Defense</i>
S. H. Murray	<i>NASA Kennedy Space Center</i>
M. Nordin	<i>Rolls-Royce Corporation</i>
E. Przybylowicz	<i>Blue Origin</i>
S. Rose	<i>The Boeing Company</i>
M. Sapp	<i>NAVAIR</i>
D. Sheldon	<i>Roll Forming Corporation</i>
G. Trepus	<i>Blue Origin</i>
R. Trudelle	<i>Pro-Weld Services LLC</i>

Advisors to the AWS D17 Committee on Welding in the Aircraft and Aerospace Industries

R. Adams	<i>Consultant</i>
M. Bernasek	<i>C-SPEC</i>
C. Carl	<i>NASA Kennedy Space Center</i>
R. Freeman	<i>Performance Review Institute</i>
W. Guo	<i>Honeywell</i>
D. Ponder	<i>Triumph Airborne Structures</i>
J. Thyssen	<i>Consultant</i>

AWS D17K Subcommittee on Fusion Welding

G. Trepus, Chair	<i>Blue Origin</i>
A. J. Pfaller, Vice Chair	<i>Miller Electric Precision Welding Solutions</i>
M. Diaz, Secretary	<i>American Welding Society</i>
H. K. Bagheri	<i>University of Ottawa</i>
R. Beil	<i>Northrop Grumman Corporation</i>
D. J. Benos	<i>Consultant</i>
J. Bollin	<i>GE Aerospace</i>
S. Brown	<i>Parker Aerospace – Exotic Metals Forming Div.</i>

M. W. Bumgarner	<i>Consultant</i>
L. Cheung	<i>Blue Origin</i>
G. W. Coleman	<i>CWICLLC</i>
P. E. Daum	<i>Rolls-Royce Corporation</i>
C. Dickson, III	<i>Lockheed Martin Aeronautics</i>
H. Doucette	<i>Consultant</i>
E. Fusner	<i>Magellan Aerospace</i>
H. Guo	<i>Eaton Aerospace Group</i>
K. Izor	<i>Pratt & Whitney</i>
N. James	<i>Seyer Industries</i>
L. Johannes	<i>NASA Johnson Space Center</i>
E. Karlen	<i>Collins Aerospace</i>
S. Krem	<i>Howmet Aerospace</i>
M. R. Lanouette	<i>The Boeing Company</i>
B. E. Lowe	<i>GE Aerospace</i>
M. Ludmer	<i>Advanced Weldtec Inc.</i>
S. C. Maitland	<i>Collins Aerospace an RTX Company</i>
L. D. Morris	<i>RTX – Raytheon Missiles and Defense</i>
R. Mulcahy	<i>Blue Origin</i>
S. H. Murray	<i>NASA Kennedy Space Center</i>
M. Nordin	<i>Rolls-Royce Corporation</i>
S. Panero	<i>Pratt & Whitney Canada</i>
E. Przybylowicz	<i>Blue Origin</i>
J. S. Romanetz	<i>Aerodyn Engineering</i>
J. Rosine	<i>Northrop Grumman Corporation</i>
M. Sapp	<i>NAVAIR</i>
D. D. Sheldon	<i>Roll Forming Corporation</i>
T. J. Smith	<i>Earlbeck Gases & Technology</i>
R. A. Trudelle	<i>Pro-Weld Services LLC</i>
J. Tsuji	<i>IHI Corporation</i>
B. D. Worley	<i>GE Aerospace</i>

Advisors to the AWS D17K Subcommittee on Fusion Welding

R. Adams	<i>Consultant</i>
R. W. Anderson	<i>NASA-Marshall Space Flight Center</i>
M. Bernasek	<i>C-SPEC</i>
C. Carl	<i>NASA Kennedy Space Center</i>
R. Freeman	<i>Performance Review Institute</i>
W. Guo	<i>Honeywell</i>
D. S. Hoyt	<i>Maas Energy Works</i>
B. Ludwig	<i>Honeywell Aerospace</i>
R. Maust, III	<i>RTX – Raytheon Missiles and Defense</i>
J. B. Pearson	<i>LTK Engineering Services</i>
D. S. Ponder	<i>Triumph Airborne Solutions</i>
J. Thyssen	<i>Consultant</i>

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 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 fourth edition of D17.1 include the following:

In this fourth edition of D17.1, the committee made several fundamental changes to expand the use and applicability of the document for the dynamics within the industry. The criteria for welding procedure and welder qualification in Clause 5 were separated for clarity and to prevent mixing of elements. As part of this, Tables 5.1 through 5.7 were reworked for better organization and to isolate each of the requirements to a single element. Also, for qualification coupon configuration, figures were added to integrate the criteria more completely within the D17.1 specification; allowing for more independence from the external documents such as AWS B2.1.

For Non-Flight Hardware in Clause 9, the criteria for fluid service inspection was diverted to ASME B31.3.

Clause 10 is a new addition which addresses the unique criteria for Crewed Spaceflight Hardware.

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 2017 edition were made.

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Specification for Fusion Welding for Aerospace Applications

1. General Requirements

1.1 Scope. This specification contains requirements for fusion welding and nondestructive 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.

Clause 10. **Crewed Spaceflight Hardware:** Requirements in addition to baseline flight hardware welding requirements addressing the fabrication and inspection of crewed spaceflight hardware and launch vehicles.

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.

1.1.3 Crewed Spaceflight Hardware. Crewed spaceflight hardware, including launch vehicles, shall be fabricated and inspected per the additional requirements found in Clause 10. This clause may be invoked for uncrewed missions if directed by the Engineering Authority.