



AEROSPACE MATERIAL SPECIFICATION

AMS2681™**REV. B**

Issued 1982-10
Revised 2000-03
Reaffirmed 2022-01

Superseding AMS2681A

Welding, Electron-Beam

RATIONALE

AMS2681B has been reaffirmed to comply with the SAE five year review policy.

1. SCOPE:

1.1 Purpose:

This specification defines the procedures and requirements for joining metals and alloys using the electron-beam (EB) welding process.

1.2 Application:

These procedures are used typically for electron-beam welding of aerospace components in soft to hard vacuum atmospheres, but usage is not limited to such applications. EB welding for fatigue critical applications should be performed in accordance with AMS 2680.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order form a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2630	Ultrasonic Inspection, Product over 0.5 inch (12.7 mm) Thick
AMS 2631	Ultrasonic Inspection, Titanium and Titanium Alloy Bar and Billet
AMS 2632	Ultrasonic Inspection of Thin Materials, 0.50 inch (12.7 mm) and Thinner in Cross-Sectional Thickness
AMS 2680	Electron Beam Welding, For Fatigue Critical Applications
ARP1317	Electron Beam Welding
ARP1333	Nondestructive Testing of Electron Beam Welded Joints in Titanium-Base Alloys

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SAE WEB ADDRESS:

Full document details: SAE AMS2681B

For more information on this standard, visit
<https://www.sae.org/standards/content/AMS2681B/>

Documents

Document Sharing Hub

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 1417 Liquid Penetrant Examination
ASTM E 1444 Magnetic Particle Examination
ASTM E 1742 Radiographic Examination

2.3 U.S. Government Publications:

Available from DODSSP, Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-1595 Qualification of Aircraft, Missile, and Aerospace Fusion Welders

2.4 AIA Publications:

Available from National Standards Association, Inc., 1250 Eye Street, Washington, D.C. 20014.

NAS 976 Electron Beam Welding Machine

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

3.1.1 Parent Materials: Shall be as specified on the applicable part drawing. (See ARP1317 for guidelines.)

3.1.2 Filler Materials: When required, filler metal shall be as specified on the part drawing.

3.1.3 Cleaning Materials: Cleaning materials, chemical solvents, and etching solutions shall be as specified on the part drawing or in the certified welding schedule.

3.2 Equipment:

3.2.1 Electron-Beam Welding Equipment: Shall be capable of producing welds meeting the requirements of 3.6 and 3.7. Equipment conforming to NAS 976 shall be acceptable.

3.2.2 Jigs and Fixtures: All holding fixtures shall be capable of maintaining the desired configuration and tolerances during welding, providing back-up as required, and allowing required work space between the work piece and the electron gun. Back-up material used to deflect or absorb residual electron-beam energy shall be of the same alloy as the part being welded except that alternate back-up materials may be used when approved by procedure certification as in 3.4.2. Tooling within 6 inches (152 mm) of the weld joint shall be made from nonmagnetic materials or be degaussed to acceptable limits (See 3.2.3).

- 3.2.3 Degaussing: Ferromagnetic materials and tooling shall, prior to welding, be demagnetized to a level established by procedure certification (3.4.2) which prevents electron-beam deflections while welding the joint.

3.3 Preparation:

Joint and surface preparation, prior to welding, shall be as follows and shall be included as part of the approved procedure certification:

- 3.3.1 Joint Preparation: Joints shall be prepared to conform to requirements specified on the part drawing.
- 3.3.2 Edge Preparation: Edges shall be machined square and parallel to ensure proper fit-up. Joints shall have no rounded-off edges, but shall be deburred after machining. (See ARP1333 for guidelines.)
- 3.3.3 Pre-Weld Fit-Up: Gap shall not exceed the limits shown in Table 1, unless otherwise specified on the certified weld schedule:

TABLE 1 - Gap Limits

Thickness	Gap, max
Up to 0.009 inch (0.23 mm), incl	5% of joint thickness
Over 0.009 to 0.061 inch (0.23 to 1.55 mm), incl	10% of joint thickness
Over 0.061 to 1.49 inch (1.55 to 37.8 mm), incl	Not to exceed 0.010 inch (0.25 mm)
Over 1.49 inch (37.8 mm)	Not to exceed 0.005 inch (0.13 mm)

- 3.3.4 Weld Start and Run-Off Tabs: Tabs, when used, shall be of the same alloy as the detail parts being welded and shall be cleaned in the same manner as the parts. Tabs shall be integral with the part, either being machined in, or welded to, the part pieces prior to assembly.
- 3.3.5 Surface Preparation: Prior to welding surfaces of parts shall be prepared using a suitable cleaning agent and method, consistent with the alloys being welded. If solvents are used on titanium alloys, they must be nonhalogenated. Welding should commence within 40 hours after surface preparation, unless otherwise permitted or restricted by purchaser.
- 3.3.5.1 After surface preparation, parts shall be handled in the joint area with clean, lint-free gloves and shall be covered or otherwise protected to prevent contamination.