SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS4300 | REV. C

Issued 1974-03
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Superseding AMS4300B

Boron-Aluminum Composite Sheet
50 v/o 5.6B, 6061-0, For Diffusion Bonding

RATIONALE

AMS4300C has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Form

This specification covers boron filaments and 6061-0 aluminum alloy foil laminated and bonded into a composite sheet.

1.2 Application

These products have been used typically for fabrication of structural components by forming, laminating, and diffusion bonding into structural components where the composite properties of high-modulus boron filaments and aluminum alloy matrix are desirable for use up to 500 °F (260 °C), but usage is not limited to such applications.

1.3 Safety - Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards that may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms 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 cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS 3865	Boron Filaments, Tungsten Substrate, Continuous
AMS 4009	Aluminum Alloy Foil, 1.0Mg - 0.60Si - 0.30Cu - 0.20Cr (6061-0)

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM E 345	Tension Testing of Metallic Foil

3. TECHNICAL REQUIREMENTS

3.1 Material

The product shall be a monolayer of boron filaments laid on and covered with 6061-0 aluminum alloy foil, pressed and bonded to produce nominally 50% by volume each of boron filaments and aluminum alloy.

3.1.1 Boron Filaments

Shall conform to AMS 3865 with nominal filament diameter of 0.0056 inch (0.142 mm).

3.1.2 Aluminum Alloy Foil

Shall conform to AMS 4009 of the thickness required to produce 50% by volume.

3.2 Construction

3.2.1 Fabrication

The product shall be fabricated by collimated positioning of boron filaments, 130 ± 2 per inch (25.4 mm) on an aluminum alloy foil backing sheet. The boron filaments shall be secured on the foil with a suitable binder that may be driven off during the outgassing phase of subsequent diffusion bonding. Each boron filament/aluminum alloy monolayer shall be covered with an additional layer of foil of the same thickness as the backing foil.

3.2.2 Filament Gaps

There shall be not more than one 0.010-inch (0.25-mm) gap per inch (25.4 mm) of width in any 12 inches (305 mm) of length and no gap shall have a width greater than 200% of the nominal filament spacing. Determination of the number of gaps and gap width shall be made in accordance with 3.2.2.1.

3.2.2.1 Nondestructive Evaluation

Orientation of boron filaments within the product shall be determined visually or, when specified, by low-energy radiographic techniques. Locations of nonconforming gaps, crossovers, stray filaments, splices, or broken filaments shall be marked on the product in such a manner that the defective area can be removed before further fabrication.

3.2.3 Filament Crossovers

There shall be no filament crossovers or stray filaments, determined in accordance with 3.2.2.1.

3.2.4 Spliced or Broken Filaments

Spliced or broken filaments shall not exceed 0.5% of the filament count in any 10-foot (3-m) or shorter length and shall not be closer to an adjacent filament defect than 0.50 inch (12.7 mm) laterally (transverse direction) and 6.0 inches (152 mm) along the filament axis (longitudinal direction), determined in accordance with 3.2.2.1.

3.2.5 Edge Delamination

Shall not extend more than 0.05 inch (1.3 mm) from any edge.

3.2.6 Boron Fiber Volume

The volume of boron fibers shall be 50% ± 2, determined by microscopic examination of the number of 0.0056 inch (0.142 mm) diameter (using actual filament diameter) filaments per inch (25.4 mm) of width in relation to the foil thicknesses. This determination can be by actual count of the filaments visually or, when specified, on the radiograph produced in 3.2.2.1.

3.3 Properties of Boron-Aluminum Sheet

The product shall conform to the requirements as shown in Table 1; the specified values apply to the average of four determinations per test but no individual specimen shall have tensile strength or tensile modulus less than 90% of the average value specified. Tests shall be performed on specimens cut from composite panels fabricated in accordance with 3.3.1 and tested in accordance with 3.3.2. For tests at 500 °F (260 °C), specimens shall be held at the test temperature for not less than 30 minutes before testing.

TABLE 1 - TENSILE PROPERTIES

Property	At Room Temperature, ksi	At Room Temperature, MPa	At 500 °F ± 10 ksi	At 260 °C ± 6 MPa
Tensile Strength, Minimum Average				
Longitudinal	180	1241	160	1103
Transverse	15	103	7	48
Tensile Modulus, Minimum Average				
Longitudinal	30,000	206,843	25,000	172,369
Transverse	15,000	103,421	10,000	68,948

3.3.1 Fabrication of Test Panels

Test panels, approximately 7.5 inches (190 mm) square, shall be fabricated by diffusion bonding eight plies of as-received sheet. From these panels, longitudinal specimens (filament orientation at 0 degrees) and transverse specimens (filament orientation at 90 degrees) shall be cut. Processing conditions for diffusion bonding of each test panel shall be reported.

3.3.2 Tensile Tests

3.3.2.1 Specimens

Tensile specimens for longitudinal and transverse tensile property determinations shall be prepared from test panels fabricated in accordance with 3.3.1. Specimen configuration, gage length, and rate of loading shall be shown in the report.

3.3.2.2 Test Procedures

Shall be in accordance with ASTM E 345 and as follows:

3.3.2.2.1 Extensometer

An extensometer shall be used for a 1.00-inch (25.4-mm) gage length capable of being used to failure at small strains, (0.010 inch [0.25 mm]). The extensometer shall preferably be of the LVDT type. An X-Y recorder shall be used to plot a load-extension curve directly from the load cell and extensometer.

3.3.2.2.2 Cyclic Loading

All longitudinal specimens shall be cycled from 0 to 1000 pounds force (0 to 4448 N) at 0.050 inch (1.27 mm) per minute to set the grips. Transverse specimens shall not be cycled.

3.3.2.2.3 Tensile Modulus Determination

Strain gages may be used when determining modulus of elasticity in tension.

3.4 Filament Strength After Diffusion Bonding

Boron filaments shall be evaluated for embrittlement or other degradation caused by diffusion bonding. Evaluation shall be made by the bend test of 3.4.2 or, if tensile testing is specified or in case of question on the results of the bend test, by the tensile test of 3.4.3. If tensile testing is used, the average boron filament strength shall be not less than 400 ksi (2758 MPa). Not less than 10 individual filaments, obtained as in 3.4.1 from each diffusion bonded panel prepared in accordance with 3.3.1, shall be evaluated.

3.4.1 Filament Extraction

Extract filaments from test panels as follows:

3.4.1.1 Cut a full length of panel sufficiently wide to yield approximately 25 filaments.

3.4.1.2 Completely submerge the panel section in a suitable sodium hydroxide solution and allow to stand until the matrix is completely dissolved. If necessary, spent solvent may be carefully removed and fresh solvent added.

3.4.1.3 After matrix is completely dissolved, separate the filaments from the solution and rinse with distilled water.

3.4.1.4 Examine the filaments for breakage.

3.4.1.5 Dry the filaments in an oven or desiccator.

3.4.2 Bend Test

Each boron filament shall withstand, without breaking, bending through an angle of 180 degrees around a 1.00-inch ± 0.01 (25.4-mm ± 0.2) diameter mandrel with the filament direction perpendicular to the axis of the bend. Test not less than 10 filaments from each prepared panel. All filaments tested must pass. In case of question on the bend test results, conduct the tensile strength tests in accordance with 3.4.3.

3.4.3 Tensile Test

Tensile test not less than 10 individual filaments in accordance with AMS 3865. If breaks occur in the grips, test additional filaments until 10 valid results have been obtained. Report the arithmetic mean of the 10 results and the individual values for each valid specimen, the gage length used, the gripping method, and the rate of loading.

3.5 Quality

Sheet, as received by purchaser, shall be uniform in quality and condition, smooth, as free from foreign material as commercially practicable, and free from imperfections detrimental to usage of the sheet.

3.6 Sizes and Tolerances

3.6.1 Thickness Increments

Shall be determined by filament spacing and foil thickness of each face, developed to produce 50% by volume each of boron filaments and aluminum alloy foil after diffusion bonding.

3.6.2 Width

Shall not deviate from the ordered width by more than +0.125 - 0 inch (+3.18 -0 mm).