

**AEROSPACE
MATERIAL
SPECIFICATION**

AMS 3911A
Superseding AMS 3911

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FABRICATION OF SANDWICH PANELS FOR LIGHT WEIGHT PORTABLE SHELTERS

1. SCOPE:

1.1 Purpose: This specification establishes the requirements, controls, procedures, and quality assurance requirements for fabrication of flat, adhesive-bonded, aluminum-alloy-faced sandwich structure panels using one of three basic core materials: paper honeycomb, polyurethane foam, or aramid-paper-base honeycomb.

1.2 Application: Primarily for use in fabricating light weight portable shelters.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2202	- Tolerances, Aluminum Alloy and Magnesium Alloy Sheet and Plate
AMS 2205	- Tolerances, Aluminum Alloy and Magnesium Alloy Extrusions
AMS 2350	- Standards and Test Methods
AMS 3107/1	- Primer, Adhesive, Corrosion-Inhibiting, High Durability Epoxy, -55° to +95°C (-67° to +203°F)
AMS 3687	- Adhesive Film, Humidity-Resistant, For Sandwich Panels, -55° to +95°C (-65° to +200°F)
AMS 3688	- Adhesive, Foaming, Honeycomb Core Splice, Structural, -67° to +180°F (-55° to +80°C)
AMS 3711	- Core, Honeycomb, Fibrous Aramid Base, Phenolic Coated

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- 2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate

- 2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Specifications:

O-S-595 - Sodium Dichromate, Dihydrate, Technical
 O-S-809 - Sulfuric Acid, Technical
 TT-M-261 - Methyl Ethyl Ketone, Technical
 CCC-C-440 - Cloth, Cheesecloth, Cotton, Bleached and Unbleached

2.3.2 Military Specifications:

MIL-H-21040 - Honeycomb Materials, Water Migration Resistant Type, Structural, Paper Base
 MIL-T-81533 - Trichloroethane 1.1.1 (Methylene Chloroform) Inhibited, Vapor Degreasing
 MIL-A-83377 - Adhesive Bonding (Structural) For Aerospace and Other Systems, Requirements for
 MIL-C-83400 - Core Material for Metal Sandwich Panels for Shelter Construction (Polyurethane Foam)

2.3.3 Military Standards:

MIL-STD-401 - Sandwich Construction and Core Materials, General Test Methods
 MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

3.1.1 Core Material:

3.1.1.1 Aramid-Paper-Base Honeycomb: Shall conform to AMS 3711, size designation "1/4 - 4.8" (1/4 in. (6.4 mm) cell size and 4.8 lb per cu ft (77 kg/m³) core density), unless otherwise specified.

3.1.1.2 Paper Honeycomb: Shall conform to MIL-H-21040, for fully cured, resin-treated, water migration-resistant type, structural, paper-base honeycomb, size designation "3/8 - 3.8" (3/8 in. (9.5 mm) cell size and 3.8 lb per cu ft (60 kg/m³) core density), unless otherwise specified.

3.1.1.3 Polyurethane Foam: Shall conform to MIL-C-83400, Type II (4.0 lb per cu ft (64 kg/m³) density), unless otherwise specified.

3.1.1.4 Core Controls: Inspection tests and storage of as-received core shall be as follows:

3.1.1.4.1 Honeycomb Core Each sheet of honeycomb core shall be inspected for physical damage prior to bonding. Damaged areas in the core which could result in reduced mechanical properties or impair the water migration characteristics shall be rejected. Three or more cracked or broken core cells in a 12 in. (300 mm) ribbon length shall be cause for rejection. The edges and corners of each sheet of core shall be inspected for damage. There shall be not more than two imperfections, cracks, or breaks and no imperfection shall extend more than 0.250 in. (6.25 mm) from the core edge. One core slice from each package or set shall be measured for thickness and any sheet or slice of core not conforming to the specified tolerance shall be cause for rejection of the entire package. When specified, a honeycomb core sample shall be tested for conformance to the material specification. The lot represented by a nonconforming sample shall be rejected.

3.1.1.4.2 Polyurethane Foam: Samples shall be taken from each lot and checked for density, thickness, and overall appearance.

3.1.1.4.3 Core Storage: Packages of core shall be stored in a dry area in such a manner as to protect the core slices from moisture, dust, contaminants, and damage until moved into the environmentally-controlled layup area for assembly.

3.1.2 Metal Details:

3.1.2.1 Facings: The aluminum facings shall be flat aluminum alloy sheet conforming to ASTM B209 in the alloy, temper, and size specified. Tolerances shall conform to AMS 2202. Facings shall be essentially free from corrosion, oil canning (snap-buckling), dents, scratches, and gouges; depth of scratches shall not exceed one-half the sheet thickness tolerance and dents in facings exceeding the sheet thickness shall be rejected. Facings shall be interleaved, wrapped, and packaged for shipment to protect them from physical damage and corrosion. When specified, a statement of conformance or reports of tests for mechanical properties and chemical composition of the material shall be included with each shipment.

3.1.2.2 Extrusions: Aluminum alloy extrusions to be used as panel edge members or to be integrally bonded into a sandwich panel shall conform to the specified alloy, temper, and material specification. Tolerances shall be in accordance with AMS 2205, unless otherwise specified. Extrusions shall be free of oils, lubricants, and waxes which cannot be readily removed when cleaned in accordance with the suggested procedure of MIL-A-83377. The extrusions shall be identified with a nonetching ink giving the following information: alloy, temper, die or drawing number, and manufacturer. The extrusions shall be prepared for shipment in the same manner as the facings, except that interleaving may be omitted if the extrusions are tightly banded together to prevent chafing and spalling. When specified, reports of tests for mechanical properties and chemical composition of the material shall be included with each shipment.

3.1.2.3 Metal Controls: Aluminum alloy sheet and extrusions shall be stored in an area that will provide maximum protection against corrosion from moisture or industrial contaminants. Sheet issued from storage to production shall be transported on skids or other conveyances which will keep it flat and prevent oil-canning and scratches. All surfaces of skids, shears, routers, priming racks, drying racks, storage bins, taping tables, and other equipment with which the sheet may come in contact shall be constructed to protect the sheet during all phases of the manufacturing processes.

3.1.3 Adhesive Primer:

3.1.3.1 Adhesive Primer: Shall conform to AMS 3107/1. The primer shall be compatible with epoxy-type adhesives and polyurethane coatings.

3.1.3.2 Primer Controls: The adhesive primer shall be stored at 0°F (-18°C) or below for periods not exceeding 6 months, or at 40°F (4°C) or below for periods not exceeding 2 months. When preparing for use, adhesive primer shall be warmed slowly to above the dew point before opening the container.

3.1.4 Adhesives:

3.1.4.1 Adhesive Film: Shall conform to AMS 3687.

3.1.4.2 Foaming Adhesive: Shall conform to AMS 3688.

3.1.4.3 Adhesive Controls: Adhesives shall be stored under the environmental conditions recommended by the adhesive manufacturer in an enclosure set aside for that purpose. Containers shall be protected from physical damage and from deterioration caused by moisture, chemicals, dirt, or other foreign matter. An inventory log shall be kept, indicating pertinent dates regarding storage life for each lot received. Adhesive shall be stored so as to facilitate oldest-issue-first use but no adhesive shall be used beyond the expiration date. The film adhesive and primer used for facing-to-core bonding shall be tested on the day of use for tensile lap shear requirements before being released to production. Minimum lap shear strength for acceptance shall be not lower than 3,000 psi (20 MPa) at room temperature.

3.1.5 Solutions for Chemically Cleaning Aluminum Alloy Parts: The water used in the make-up of cleaning solutions shall be either tap water having a pH of 7.5 ± 0.3 (unless compensation is accomplished through chemical adjustment) or demineralized water having a pH no higher than 7.5.

3.1.5.1 Vapor Degreaser: The vapor degreasing solvent shall be stabilized 1,1,1, trichloroethane conforming to MIL-T-81533 or other suitable degreasing solvent.

3.1.5.2 Cleaning Solution: The cleaning solution shall be prepared in accordance with the manufacturer's recommendations (See 8.2).

3.1.5.3 Acid Etch: The composition of the acid etch shall be:

Sodium Dichromate, Technical Grade (0-S-595)	2 parts by weight
Concentrated Sulphuric Acid, (0-S-809)	5 parts by weight
Water, as in 3.1.5	15 parts by weight

3.1.5.4 Cleaning Solution Controls: The cleaning solutions shall be monitored daily for temperature; tanks shall be equipped with continuous temperature recorders. The vapor degreasing solution, the cleaning solution, and the acid etch solution shall be checked three times a week to ensure proper chemical balance. If any of the cleaning solutions are out of the required limits, corrections shall be made and the solutions retested before production continues. Aluminum alloy lap shear test plates shall be cleaned in the solution daily, bonded, and tested to further ensure proper cleaning.

3.2 Equipment:

3.2.1 Cleaning Equipment: The tanks for cleaning aluminum alloy parts shall consist of corrosion-resistant steel or shall be corrosion-resistant-steel-lined for most acid solutions or lead-lined for hydrofluoric or sulphuric acid solutions. The cleaning tank line shall consist of a vapor degreaser, an acid preclean or an alkaline cleaning tank, a spray rinse tank, immersion rinse tank, acid etch tank, immersion rinse tank, and drying oven.

3.2.1.1 The tanks shall be equipped with heaters to regulate the temperature of the baths for the cleaning solutions.

3.2.1.2 Auxiliary cleaning equipment such as cleaning racks, baskets, and overhead cranes shall be used as required to protect the parts against damage during the cleaning operation.

3.2.1.3 The cleaning tanks shall be equipped with continuous recorders and timers.

3.2.2 Priming Equipment: The priming equipment shall include a tank, pump, and spray gun equipped with mixing, agitation, and recirculation features to produce a uniform sprayed coat of primer on applicable surfaces.

3.2.3 Priming Booths:



- 3.2.3.1 The priming booths used in applying primer to cleaned metal parts or core material shall be equipped with air filters, filtered air lines, and exhaust systems. The air filters shall maintain a dust count of less than 100,000 particles per cu ft (3,500,000 particles/m³) of 1 micron (m) and larger. The air handling equipment shall provide a minimum of 10 air changes per hour. All fresh and recirculated air entering the priming booths shall be filtered. The air lines used with the priming equipment shall be equipped with filters and regulators. The air line filters shall remove all moisture and contaminants from the air. The air regulators should provide the complete range of air pressures required by the priming equipment.
- 3.2.3.2 The lighting equipment used in the priming booths shall be explosion proof and equipped with clear glass or plastic covers which can be easily removed and cleaned.
- 3.2.3.3 The priming booths should have doors equipped with limit switches which render the priming equipment inoperable when the doors are open.
- 3.2.4 Curing Presses: The presses used for curing the sandwich panels shall be capable of applying not less than 40 psig (275 kPag) and 290°F (145°C) over the entire platen surface. The platens shall be flat within a total indicator reading (TIR) of 0.010 in. (0.25 mm). The press shall be equipped with time, temperature, and pressure recorders. It is desirable that the presses be equipped with automatic programmers to control accurately heat-up rate, pressure application, dwell time, cool down, and pressure removal. The press should also be equipped with suitable aluminum "pull in" plates which will facilitate moving the sandwich panel layup into the press without misaligning the layup.
- 3.2.5 Mechanical Handling Equipment: The equipment for handling panels after curing shall not damage the panel, such as overhead cranes with fabric slings, skids, or conveyances. The skids or conveyances should provide flat, soft surfaces which will not scratch or dent the panels.