



AEROSPACE MATERIAL SPECIFICATION

AMS-C-7438™**REV. A**

Issued 1999-06
Revised 2014-07
Reaffirmed 2022-08

Superseding AMS-C-7438

Core Material, Aluminum,
for Sandwich Construction

FSC 5680

RATIONALE

AMS-C-7438 and its predecessor—MIL-C-7438G, Amendment 1—form the basis for all aluminum core specifications worldwide. These specifications are included by reference in most aluminum core specifications, and mechanical properties are consistent throughout the industry. Revision A of AMS-C-7438 removes requirements which are deemed no longer relevant or necessary, and improves clarity of requirements which remain relevant to the industry. Grade C core materials (Alloy 2024-T81) have been removed because 2024 foil is considered unavailable for the foreseeable future.

AMS-C-7438A has been reaffirmed to comply with the SAE Five-Year Review policy.

NOTICE

The initial release of this document has been taken directly from U.S. Military Specification MIL-C-7438G, Amendment 1 and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. This document replaces MIL-C-7438G, Amendment 1. Any part numbers established by the original specification remain unchanged. The current revision of this document includes changes that were not a part of MIL-C-7438G, Amendment 1.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

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Documents

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1. SCOPE

1.1 Scope

This specification covers treated aluminum core material for structural sandwich construction.

1.2 Classification

- 1.2.1 Aluminum core material for sandwich construction shall be furnished in the following grades, as specified (See 6.3.1 and 6.5):

Grade	Description
B	For exposure up to 350 °F (See 3.2.1.1).

- 1.2.2 Aluminum core material for sandwich construction shall be furnished in the following classes, as specified (See 6.3.1 and 6.5):

Class	Description
1	High corrosion resistance (See 3.2.2).
2	Standard corrosion resistance (See 3.2.2).

- 1.2.3 Aluminum core material for sandwich construction shall be furnished in the following types, as specified (See 6.3.1 and 6.5):

Type	Description
N	Non-perforated (See 3.3.2).
P	Perforated (See 3.3.2).
HP	Highly Perforated (See 3.3.2).

2. REFERENCES

2.1 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.

2.1.1 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-A-81596 Aluminum Foil for Sandwich Construction

AMS-STD-401 Sandwich Construction and Core Materials, General Test Methods

AMS-QQ-A-250/4 Aluminum Alloy 2024, Plate and Sheet

AMS-QQ-A-250/5 Aluminum Alloy Alclad 2024, Plate and Sheet

2.1.2 ASQ Publications

Available from American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, Tel: 800-248-1946 (United States or Canada), 001-800-514-1564 (Mexico), or +1-414-272-8575 (all other locations), www.asq.org.

ANSI/ASQ Z1.4 Sampling Procedures and Tables for Inspection by Attributes

2.1.3 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 117 Salt Spray (Fog) Testing

ASTM C 366 Measurement of Thickness of Sandwich Cores

ASTM D 3951 Commercial Packaging, Practice for

ASTM D 1974 Standard Practice for Method of Closing, Sealing, and Reinforcing Fiberboard Shipping Containers

ASTM D 5118 Standard Practice for Fabrication of Fiberboard Shipping Boxes

ASTM D 5168 Standard Practice for Fabrication and Closure of Triple Wall Corrugated Fiberboard Containers

ASTM D 6251 Standard Specification for Natural Wood-Cleated Panelboard Shipping Boxes

2.1.4 U.S. Government Publications

Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6396, <http://quicksearch.dla.mil/>.

MIL-STD-2073-1 Standard Practice for Military Packaging

A-A-203 Paper, Kraft, Untreated

MIL-DTL-17667 Paper, Wrapping, Chemically Neutral (Non-Corrosive)

2.1.5 Order of precedence

In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

2.2 Definitions

The following definitions apply to terms that are uncommon or have special meaning as used in this specification:

2.2.1 BLOCK: A volume of honeycomb material that is created during node adhesive bonding. This term may be used for material that has or has not been expanded to its nominal cell size and density. Slices of various thicknesses are cut from blocks.

2.2.2 BUCKLED CELL WALLS: Permanent buckling or crushing in the thickness direction of greater than 0.010 inch. Also called columnar buckling or columnar failure.

2.2.3 DOUBLE FOILS: A stacking misalignment defect that can occur for honeycomb that is manufactured using a corrugation process or an expansion process. See Figure 1 for a depiction of this defect. This defect is comprised of two or more adjacent ribbons of foil.

2.2.4 FLAKES: Excess metal attached to foil edges which do not interfere with core thickness measurement. Also called foil edge burrs.

2.2.5 LOOSE METAL: Loose pieces of honeycomb or foil.

- 2.2.6 **MISMATCHED NODES:** A stacking misalignment defect that can occur for honeycomb that is manufactured using a corrugation process, rather than an expansion process. See Figure 1 for a depiction of this defect.
- 2.2.7 **NOTCH:** Removed material from part of a cell wall that has a depth (in the T direction) of at least 0.020 inches. This does not include intended features that are part of the engineering drawing/definition. Notches are also called gouged cell walls.
- 2.2.8 **ROLLED METAL:** Cell walls that are bent over at the top or bottom surface of the core. When viewed in the T direction, this causes an increase in the apparent foil thickness.
- 2.2.9 **SLICE:** A constant thickness volume of honeycomb material that is sliced or removed from a block of greater thickness. This term may be used for material that has or has not been expanded to its nominal cell size and density.
- 2.2.10 **SPLIT CELL WALLS:** Tears in the cell wall that extend greater than 0.03 inch below the surface.
- 2.2.11 **UNBONDED NODES:** Separation across the full width of a node bond, for greater than 50% of the core thickness.

3. REQUIREMENTS

3.1 First article

When specified, samples shall be subjected to first article inspection (See 4.5 and 6.4).

3.2 Materials

The materials comprising the core shall conform to the applicable specifications and as specified herein.

3.2.1 Metal

The core shall be fabricated from aluminum alloy foil conforming to AMS-A-81596.

3.2.1.1 Grade B

Grade B core shall be of Alloy 5052 or Alloy 5056 foil, as specified (See 3.2.4 and 6.3.1). After foil is processed into Grade B core, the temper shall be optional.

3.2.2 Metal Finish

The core shall be formed from chemically treated or coated foil for protection against corrosion (See 3.7). The chemical treatment or coating shall be applied to the foil, prior to application of bonding material (See 3.2.3).

3.2.3 Bonding material

The adhesive used to bond the aluminum foil to form the cells of the core shall be of such quality that the resultant core will meet the requirements specified herein.

3.2.4 Trade name and code number

The manufacturer shall designate each core material combination by a trade name and code number which shall be used to identify the core (See 6.3.1). The code number shall consist of the following:

- a. Designated density.
- b. Cell size in fractions of an inch.
- c. Nominal foil thickness in ten-thousandths of an inch.
- d. "P" for perforation, if so specified (See 3.3.2). For non-perforation, no coding required. "N" for Type N, "P" for Type P, or "HP" for Type HP.
- e. Alloy (standard designation). If applicable, temper required (See 3.2.1.2).
- f. For hexagonal core cell walls, "C" for corrugated if so specified. For expanded, no coding required.
- g. "S" for special core cell configurations, if other than hexagonal.
- h. "CL1" for Class 1, "CL2" for Class 2.

Example: Grade B material with a density of 4.5 pounds per cubic foot, fabricated with a 1/8-inch cell size, and 0.0010 inch nominal thickness, nonperforated and using corrugated Class 2 Alloy 5052 shall be coded as follows:

Trade name - 4.5 -1/8-10(5052N)C-CL2

If the core cell configuration is other than hexagonal, such as reinforced hexagonal, double corrugated, or staggered hexagonal, then the core shall be coded as follows:

Trade name - 8.1 -3/16-30(5056HP)S-CL1

3.3 Fabrication

3.3.1 Configuration

The core material shall consist of ribbons of aluminum foil bonded together to form cells approximately of uniform shapes, usually hexagonal in shape. The cores shall be made either by assembling corrugated ribbons or by strip-bonding flat ribbons and then expanding the core cells to proper shape. If the core material is purchased in the unexpanded condition, it shall be capable of meeting the requirements of this specification after proper expansion to the full cell configuration and proper density.

3.3.2 Perforation

Unless otherwise specified (See 6.3.1), the aluminum foil shall be non-perforated. When perforation Type P or HP is specified, the perforations shall be of such size and location that all cells are vented at least every 1/4 inch in thickness dimension. When Type HP is specified, there shall be no fewer than 6000 perforations per square foot of foil, uniformly spaced and staggered.

3.3.3 Form

The core shall be furnished as pieces, unexpanded blocks or slices, or expanded slices as specified by purchaser. The dimensions and tolerances for the pieces, blocks, or slices shall be as specified by purchaser.

3.4 Physical properties

Physical properties and tolerances shall be in accordance with Table 1.

3.4.1 Foil thickness

The core foil thickness shall be within the limits of designated value specified in Table 2.

3.5 Compressive and shear strength properties of hexagonal configuration core

Core flatwise compressive strength and shear strength (associated with shear distortion in the LT and WT planes, see Figure 2) for the nominal density of the core shall conform to the requirements listed in Table 3 as applicable for the basis metal and test conditions. Compressive strength and shear strength of any specimen shall be not less than the value specified in the applicable tables (See Tables 4 to 7) when tested in accordance with the applicable test procedure (See 4.7.5 to 4.7.8). When shear strength is determined by using the beam flexural shear test, the facings of the core sandwich shall be Alloy 2024-T3 or 2024-T81 bare, conforming to AMS-QQ-A-250/4, or clad, conforming to AMS-QQ-A-250/5.

3.6 Delamination strength

The core shall have a delamination strength or node bond strength capable of withstanding not less than the ultimate tensile load specified in Table 8 when tested in accordance with the applicable test procedure (See 4.7.9).

3.7 Corrosion resistance properties

The material shall be treated so as to be capable of protecting the base metal when subjected to the salt spray test specified in 4.7.10. At the end of 30 days exposure, Class 1 core shall not show a loss of weight greater than 20 milligrams per square foot of exposed foil area. At the end of 30 days exposure, Class 2 core shall not show a loss of weight greater than 125 milligrams per square foot of exposed foil area.

3.8 Mechanical properties of special core configuration

The mechanical properties of special core configuration or hexagonal configuration material not specified herein, shall be specified in the contract or purchase order, or covered by applicable drawings (See 6.3.1).

3.9 Workmanship

Clean, lint-free gloves shall be worn when handling core material. The core material shall be clean and free from grease, oil, lotion, release agent, silicone, tape residue, moisture, or dirt.

3.9.1 Visual imperfections

Visual imperfections shall not exceed the values specified in Table 9 for the specified cell size (See 4.6.2.1.1).

3.9.2 Mismatched nodes

The c/d ratio (See Figure 1) of mismatched nodes for corrugated core shall not exceed 0.25 (See 4.6.2.1.1).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection

Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by purchaser. Purchaser reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Sampling

Unless otherwise specified, sampling plans and procedures in the determination of the acceptability of products shall be in accordance with the provisions set forth in ANSI/ASQ Z1.4.

4.3 Lot

Unless otherwise specified in the contract or order (See 6.3.1), a lot shall consist of not more than 1000 cubic feet of expanded material of the same designated cell size dimension, nominal foil thickness, density, perforation, alloy composition, Class, and core configuration design, manufactured under essentially the same conditions.

4.4 Classification of inspection

The inspection requirements specified herein are classified as follows:

- a. First article inspection (See 4.5).
- b. Quality conformance inspection (See 4.6).

4.5 First article inspection

First article inspection shall consist of all inspection procedures of this specification (See 4.6, 4.7 and Table 11). The responsibility for the performance of the first article inspection shall be as specified by purchaser (See 6.3.1 and 6.4).

4.5.1 Test samples

The first article test samples shall consist of material cut to a thickness of 0.625 inch $\pm$ 0.010 for Grade B. In addition, sufficient material for the plate shear tests or sandwich specimens for flexural tests shall be provided for a minimum of 5 specimens for each applicable direction and temperature determination. First article samples (of designated density, cell size dimension, nominal foil thickness, alloy composition, finish, core cell configuration, and Type) which are selected shall have been manufactured using the same production processes, materials, procedures and equipment which will be used in filling the contract.

4.5.2 Certified statement

Whether or not a first article sample is required (See 4.5.3), the contractor shall supply a certified statement of alloy composition and prior tests which shows the material furnished complies with the requirements of this specification. The statement shall also include the revision of this specification, purchase order number, block or lot number, size, quantity, foil lot numbers, Grade, manufacturer's trade name and code number for the material (See 6.4). The supplier of core shall furnish with each shipment a report from the manufacturer showing the results of tests to determine conformance to the acceptance test requirements.

4.5.3 Prior approval

If a contractor has previously delivered material in accordance with the requirements of this specification and his product has been found to be satisfactory, the requirements for first article inspection for that product, in connection with any subsequent contract or order for that product, are fulfilled unless purchaser requests a first article. However, first article inspection is required when a contractor changes his material or process. (See 6.3.1 and 6.4). The approval of first article samples or the waiving of the first article inspection shall not relieve the contractor of his obligation to fulfill all other requirements of the specifications and contract.

4.5.4 Further production

Any production of core material by the contractor prior to approval of purchaser shall be at the contractor's risk.

4.6 Quality conformance inspection

4.6.1 Sampling

Samples shall be taken at random from each inspection lot. Failure of any specimen, and (if applicable) any of its corresponding retest specimens to meet the requirements of this specification shall constitute cause for rejection of the lot represented (See 4.8). The contractor shall furnish all samples and shall be responsible for accomplishing the required tests.

4.6.1.1 Visual and dimensional examination

Samples shall be selected in accordance with ANSI/ASQ Z1.4, Inspection Level II, Acceptable Quality Level 2.5 percent defective for visual and dimensional examination (See 4.6.2.1).

4.6.1.2 Physical and mechanical properties

Sufficient material shall be selected to conduct the tests detailed in Table 10 applicable for the Grade of core.

4.6.1.3 Corrosion resistance properties

Five (5) test specimens, shall be selected from each inspection lot to conduct the test detailed in 4.7.10 (See Table 10). Quarterly sampling is permitted for a type of metal finish, when the 10 previous, consecutive tests (50 specimens) are passing and manufactured with the same process and equipment. In lieu of sampling each inspection lot, the contractor shall be permitted once each period of three months to select a minimum of 5 random specimens for that type of metal finish from his production line, for determination of corrosion resistance properties.

4.6.2 Tests

The quality conformance tests shall consist of examination as specified in 4.6.2.1 and in Table 10. The tests shall be in conformance with the applicable requirements of Section 3, except as noted. In addition, the material shall be subjected to any other tests specified herein which purchaser considers necessary to determine conformance with this specification.

4.6.2.1 Examination

The material, selected in accordance with 4.6.1.1, shall be examined to determine compliance with the requirements of this specification for configuration, perforation, size identification, workmanship and double foils, visual imperfections and mismatched nodes. Except for the maximum number of imperfections allowed as indicated in Table 9 (See 4.6.2.1.1), material whose sample contains one or more defects shall be rejected. Figure 1 illustrates double foils and mismatched nodes.

4.6.2.1.1 Visual imperfections

A square foot of each selected sample item shall be examined for the number of mismatched nodes, loose metal, flakes, unbonded nodes, split cell walls and buckled cell walls. The c/d ratio of mismatched nodes shall also be determined. If the number of nonconforming imperfections exceeds the acceptance number for that defect as stated in Table 9 or the c/d ratio of mismatched nodes is greater than the specified value, the lot represented by the sample shall be rejected.

4.6.2.2 Physical, mechanical and corrosion resistance properties

The material selected shall be tested in accordance with Table 10.