SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

AMS 4176C

Issued NOV 1970
Revised JUL 1992
Noncurrent MAR 1992
Cancelled NOV 2001
Superseded by AMS 4349
Superseding AMS 4176B

Honeycomb Core, Aluminum Alloy
For Sandwich Construction
5056, 350 (175)

(Composition similar to UNS A95096)

CANCELLATION NOTICE

This specification has been declared "CANCELLED" by the Aerospace Materials Division, SAE, as of November 2001, and has been superseded by AMS 4349. The requirements of the latest issue of AMS 4349 shall be fulfilled whenever reference is made to the cancelled AMS 4176. By this action, this document will remain listed in the Numerical Section of the Index of Aerospace Material Specifications noting that it is superseded by AMS 4349.

Cancelled specifications are available from SAE.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright 2001 Society of Automotive Engineers, Inc.
All rights reserved.

Printed in U.S.A.

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

AVA Documents
Document Sharing Hub

Full document details: SAE AMS4176C

1. SCOPE:

1.1 Form:

This specification covers one type of honeycomb core made of aluminum alloy and supplied in the form of blocks, slices, or other configurations as ordered.

1.2 Application:

Primarily for use in sandwich construction for short-term exposure, as in missile or space applications, to temperatures up to 350° F (175° C), or for long-term exposure, as in aircraft applications, to temperatures up to 200° F (95° C).

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 2350 Standards and Test Methods
AMS 4005 Aluminum Alloy Foil, 5.0Mg - 0.12Mn - 0.12Cr (5056-H191)

2.2 ASTM Publications:

Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM C273 Shear Test in Flatwise Plane of Flat Sandwich Constructions or Sandwich Cores
ASTM C365 Flatwise Compressive Strength of Sandwich Cores

2.3 Government Publications:

Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

FED-STD-595 Color

2.3.2 Military Standards:

MIL-STD-794 Parts and Equipment, Procedures for Packaging and Packing of

Documents
Document Sharing Hub
Full document details: SAE AMS4176C

3. TECHNICAL REQUIREMENTS:

3.1 Material:

3.1.1 Metal: Shall be AMS 4005 (5056-H191) aluminum alloy foil of the thickness specified in the designation on the drawing or purchase order.

3.1.2 Adhesive: The adhesive system used for node-to-node attachment shall be selected at the option of the core manufacturer such that the resultant core meets the requirements specified herein.

3.2 Configuration:

The core material shall consist of strips of aluminum alloy foil bonded together such that cells approximately hexagonal in shape are formed when fully expanded (See Fig. 1).

3.2.1 Designation: Core shall be designated according to the following numbering system:

a. Nominal density, lb per cu ft (kg/m^3)

b. Cell size, in. (mm)

c. Foil thickness, ten-thousandths in. (µm)

d. “N” for nonperforated or “P” for perforated

e. Alloy

f. Adhesive, option of supplier, unless otherwise specified

Example: Core with a nominal density of 4.3 lb per cu ft (68.9 kg/m^3) with a 1/4 in. (6.4 mm) cell size, 0.0020 in. (51 µm) foil thickness, nonperforated, made of AMS 4005 alloy, and bonded with required adhesive shall be numbered as follows:

4.3 - 1/4 20N (5056) (XXXX) in U.S. Conventional units
68.9 - 6.4 51N (5056) (XXXX) in SI units

3.2.2 Perforations: When perforated core is specified, the perforations shall be approximately 0.005 in. (0.13 mm) in diameter and spaced to vent each cell into at least three adjacent cells at least once per 1/4 in. (6.4 mm) of core thickness. When thicknesses less than 1/4 in. (6.4 mm) are furnished, there shall be at least one perforation per cell into each of three adjacent cells.

3.2.3 Cell Pitch: Shall be 1.733 times the nominal cell size, +20%, -10%, measured by taking the average distance between 10 nodes along a ribbon for 6 different ribbons.

Documents
Document Sharing Hub
Full document details: SAE AMS4176C

3.3 Condition:

Core shall be clean and free of contamination; it shall be supplied in the expanded form, unless otherwise specified.

3.4 Properties:

Core having nominal dimensions as specified in Table I shall conform to the following requirements; tests shall be conducted on the core supplied and in accordance with specified test methods. Properties of core having nominal dimensions other than specified in Table I shall be as agreed upon by purchaser and vendor.

3.4.1 Flatwise Compressive Strength: The minimum individual values shall be as specified in Table I, determined in accordance with 4.5.1.

3.4.2 Plate Shear Strength and Plate Shear Modulus: Shall be as specified in Table I, determined in accordance with ASTM C273 at 77° F ± 5 (25° ± 3), using a 0.625-in. (15.88-mm) thick specimen.

3.4.3 Node Bond Strength: Shall be not less than 30 lb (133 N) at 77° F ± 5 (25° ± 3) and not less than 15 lb (66.7 N) at 350° F ± 5 (177° C ± 3), determined in accordance with 4.5.2. In case of partial delamination at the minimum specified load, the delamination shall be less than 10% of the total stress section of the core slice.

3.4.4 Core Density: Shall be within ±10% of the nominal specified density, determined in accordance with 4.5.3.

3.5 Quality:

The core, as received by the purchaser, shall be uniform in quality and free from imperfections detrimental to usage of the core.

3.5.1 Cleanliness: The core shall be free from corrosion, oil, and other contamination detrimental to bonding.

3.5.2 Discoloration: A change in color of core material shall be acceptable provided the color change occurs in a line parallel to “L” (Fig. 1), indicative of a change in foil material where more than one foil coil is used in the manufacture of a core block. All other discolorations of core material, such as spots, will be unacceptable.

3.5.3 Flatness: Expanded core shall make total facing contact with a flat surface under uniform pressure without resulting in any damage that would cause core rejection.

3.5.4 Double Foils: Expanded core splices which have double foils (two ribbons bonded together which cause uneven expansion in the “L” direction (Fig. 1)) shall be acceptable if the double foils are not more frequent than one in any 8 in. (203 mm).

Documents
Document Sharing Hub
Full document details: SAE AMS4176C

3.5.5 Mismatched Nodes: The c/d ratio (See Fig. 2) of mismatched nodes shall be 0.00 to 0.25.

3.5.6 Visual Imperfections: The following maximum requirements apply for imperfections observed in any randomly selected 12-in. or 305-mm diameter circle:

	Maximum Number for Cell Size, Inch (mm), Shown				
Type of Imperfection	1/8(3.2)	5/32(4.0)	3/16(4.8)	1/4(6.4)	3/8(9.5)
Mismatched Nodes	70	55	40	25	10
Loose Metal or Flakes (3.5.6.1)	35	28	20	12	5
Split Cell Walls	0	0	0	0	0
Buckled Cell Walls	0	0	0	0	0
Unbonded Nodes	2	2	2	2	2

3.5.6.1 Flakes are excess metal attached to foil edges which do not interfere with measurement of core thickness.

3.6 Sizes and Tolerances:

3.6.1 Size: Core shall be supplied in the size ordered, with core dimensions as shown in Fig.1, where,

T = Thickness, depth, or height dimension, measured parallel to the core cell size
L = Longitudinal or ribbon (length) dimension, measured along the direction of a ribbon
W = Width dimension, measured normal to the ribbon direction

3.6.2 Core Thickness Tolerance: Shall be ±0.005 in. (±0.13 mm) for machined slices up to 4.0 in. or 100 mm in nominal thickness, ±0.062 in. (±1.57 mm) for machined slices over 4 in. or 100 mm in nominal thickness; and +0.25 in. (+6.4 mm), -0.00 for raw block.

3.6.3 “L” and “W” Tolerance: Length and width of unexpanded core shall be as ordered, +0.25 in. (+6.4 mm), -0; for expanded core, tolerances shall be +2 in. (+50.8 mm), -0.

3.6.4 Average Cell Size Tolerance: The cell size of any 10 adjacent cells shall not vary more than ±10% from nominal, determined by taking the average distance between node bonds along the “W” dimension (Fig. 1) for at least 60 cells selected at random in groups containing 10 adjacent cells.

3.6.5 Ribbon Direction Tolerance: All ribbons shall be parallel to each other with 10 deg (0.175 rad). The ribbon direction shall be determined by measuring the angle between one line through two nodes on the same ribbon (“L” direction), 12 in. or 300 mm apart, and another line in the principal ribbon direction (See Fig. 1).

Documents
Document Sharing Hub
Full document details: SAE AMS4176C