

Aluminum Foil for Sandwich Construction

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## 1. SCOPE:

## 1.1 Scope:

This specification covers the requirements of uncoated aluminum alloy foil for core materials required for structural sandwich construction.

## 1.2 Classification:

Aluminum foil material for sandwich construction shall be furnished in the following alloys and tempers, as specified (see 6.2.1):

Aluminum alloy	Temper	Description
2024	T 3	Solution heat-treated and then cold worked.
	T 81	Solution heat-treated, cold worked, and then artificially aged.
3003	H 19	Strain hardened, extra hard temper.
5052	H 191	Strain hardened, extra hard temper variation.
5056	H 191	Strain hardened, extra hard temper variation.

## 2. APPLICABLE DOCUMENTS:

The following publications, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

## 2.1 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-H-6088 Heat Treatment of Aluminum Alloys

MIL-STD-649 Aluminum and Magnesium Products, Preparation for Shipment and Storage

L-T-80 Tape, Pressure-Sensitive Adhesive (Aluminum Backed)

FED-STD-151 Metals; Test Methods

FED-STD-184 Identification Marking of Aluminum, Magnesium and Titanium

## 2.2 ASTM Publications:

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

ASTM E 252 Thickness of Thin Foil and Film by Weighing  
ASTM E 345 Tension Testing of Metallic Foil

## 3. REQUIREMENTS:

### 3.1 Chemical composition:

Aluminum foil shall be produced from material conforming to the requirements specified in Table I.

### 3.2 Mechanical properties:

The mechanical properties, perpendicular to the direction of final rolling (long transverse direction) for Alloy 2024 and parallel to the direction of final rolling (longitudinal direction) for Alloys 3003, 5052, and 5056, shall conform to the requirements of Table II for the alloy and temper specified. Mechanical properties of alloys and tempers not covered by this specification shall be as specified in the contract or order (see 6.2.1).

### 3.3 Thickness:

Unless otherwise specified, aluminum foil shall be furnished in the thicknesses as shown in Table III, as specified in the contract or purchase order (see 6.2.1). The thickness of the aluminum foil shall not vary from the specified thickness by more than permitted variations shown in Table III. Unless otherwise specified in the contract or purchase order, for thicknesses of foil not covered herein, the thickness shall not deviate from that specified by more than  $\pm 10$  percent of that specified for Alloy 2024 or by more than  $\pm 5$  percent of that specified for the other alloys.

### 3.4 Dimensional tolerances:

Unless otherwise specified, the aluminum foil shall be furnished in coils. The weight of the coils shall be as specified in the contract or purchase order (see 6.2.1). The width of the foil shall be as specified in the contract or purchase order (see 6.2.1). The width of the foil shall be within  $\pm 1/32$  inch of that specified. Unless otherwise specified, the coil diameter shall not exceed 34 inches (see 6.2.1).

### 3.5 Splices:

The maximum number of allowable splices per roll of aluminum foil shall be one for each 1,300 lineal feet or fraction thereof for Alloy 2024, and one for each 3,000 lineal feet or fraction thereof of foils in other alloys regardless of nominal foil thickness. Unless otherwise specified, the splices shall be made with pressure-sensitive tape conforming to L-T-80 or by ultrasonic welding. The type of splice shall be at the supplier's option in accordance with his current mill practices as long as there are no loose foil edges in the foil roll unwind direction. Splices shall be marked with a colored tape, or equivalent, that shall extend over each edge of the roll so that the matching tape may be easily seen at the edges of the roll.

### 3.6 Marking for identification:

Unless otherwise specified, the foil shall be marked in accordance with FED-STD-184.

### 3.7 Heat treatment:

The heat treating required for aluminum Alloy 2024 foil shall be performed in accordance with the applicable procedures in MIL-H-6088.

### 3.8 Workmanship:

The foil shall be uniform in quality and condition; clean, sound, smooth, commercially flat, and free from buckles, blisters, seams, laminations, wrinkles, excessive bow, mill holes, and other injurious defects, both internal and external, that will be detrimental to fabrication of structural core material. Oil on the foil surface in amounts which would prevent the application of adhesive and attainment of a bond shall not be acceptable. Discoloration due to thermal treatment shall not be cause for rejection.

## 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 the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

### 4.2 Lot:

Unless otherwise specified in the contract or purchase order, a lot shall consist of all foil of the same heat, alloy, temper, and nominal thickness processed together. For the coiled foil, prior to shearing to cut length or slitting into multiple coils, a lot shall have a maximum weight of 40,000 pounds.

### 4.3 Sampling:

Unless otherwise specified and where applicable, the supplier shall use a system of statistical quality control approved by the acquiring activity for sampling plans and procedures in the determination of the acceptability of the products.

#### 4.3.1 Quality conformance samples:

4.3.1.1 For visual examination and dimensional tolerances: Samples for visual examination and dimensional tolerances shall be selected from each coil in accordance with the supplier's system of statistical quality control (see 4.3). Unless in conflict with the supplier's system, the sample footage shall consist of equal lengths of strips taken from the head and tail of each coil prior to shearing to length or slitting into multiple coils.

#### 4.3.1.2 For chemical analysis:

4.3.1.2.1 Ingot sampling: At least one sample shall be taken from each group of ingots of the same alloy poured simultaneously from the same source of molten metal of the test of 4.5.1. Complete ingot analysis records shall be available to the acquiring activity.

4.3.1.2.2 Finished product sampling: When sampling has not been made in accordance with 4.3.1.2.1 or compliance with 4.3.1.2.1 can not be established, a random sample for each 2,000 pounds, or fraction thereof, of material of each alloy in the lot shall be selected for test of 4.5.1.

4.3.1.3 For mechanical tests: At least two samples from each end of the coil for specimens for each 2,000 pounds, or fraction thereof, shall be taken in accordance with 4.3.2 to represent a lot, but not more than two samples shall be taken from each end of a mill coil even though slit into narrower coils or cut into shorter coils, provided that further production does not change the temper.

#### 4.3.2 Quality conformance specimen preparation:

4.3.2.1 Chemical analysis preparation: Samples for chemical analysis shall be prepared as described in Method 111 or Method 112 of FED-STD-151.

4.3.2.1.1 Chemical analysis: A composite sample of at least 75 grams of foil, chips, or drillings shall be obtained by cutting, drilling, or machining the sample of 4.3.2.1 in accordance with Method III of FED-STD-151. Chips or drillings shall be cleaned with a magnet.

4.3.2.1.2 Spectrochemical analysis: A piece of metal weighing not less than 60 grams shall be taken from each sample of 4.3.2.1. Specimens for spectrochemical analysis shall be prepared in accordance with Method 112 of FED-STD-151.

4.3.2.2 Specimens for mechanical tests: For the non-heat-treatable alloys 3003, 5052, and 5056, tension test specimens shall be prepared in such a manner that the longitudinal axis is parallel to the direction of rolling or maximum flow of the metal in the coil. For the heat-treatable alloy 2024, tension test specimens shall be prepared in such a manner that the longitudinal axis is at an angle of 90 degrees to the direction of rolling or maximum flow of the metal in the coil. The tension test specimens for foil shall be machined (see 4.3.2.2.1) or they shall be sheared (see 4.3.2.2.2). Either type of prepared specimen shall be examined under 20X magnification to determine that the edges are smooth and that there are no surface irregularities.

- 4.3.2.2.1 Machined specimen: Tensile test specimens for foil shall be machined to the form and dimensions of Type A specimens as detailed in ASTM E 345. The specimens shall be machined in packs by use of a milling type cutter which should be kept very sharp and should be renewed when necessary. For satisfactory results, a film of polyester terephthalate or similar material should be interleaved between foil thicknesses when machining them.
- 4.3.2.2.2 Sheared specimens: Tensile test specimens for foil shall be individually prepared by shearing to the form and dimensions of Type B specimens as detailed in ASTM E 345.
- 4.3.2.3 Specimens for thickness: Specimens for thickness shall be prepared for determining thickness either by instrument measurement or by weighing of the foil.
- 4.3.2.3.1 Instrument measurement specimens: Specimens of foil for instrument measurement of thickness shall be cut or sheared to form a strip approximately 2 inches wide by the width of the foil.
- 4.3.2.3.2 Weighing measurement specimens: Specimens individually prepared in accordance with 4.3.2.2.2 may be used for thickness specimens. Specimens may also be cut from the foil by a precision blanking press in the form of circles that are  $8.000 \pm 0.008$  square inches in area as detailed in ASTM E 252. At the option of the supplier, other size specimens may be used provided consideration is given to factors affecting the results, that the area of the specimen shall be known and controlled to an accuracy of  $\pm 0.1$  percent, and the minimum weight of the specimen shall be 0.070 grams.
- 4.4 Quality conformance examination:
- 4.4.1 Products: Each coil or samples of foil selected in accordance with 4.3.1.1 shall be visually examined for conformance to the requirements of form (see 3.4), splicing (see 3.5), marking for identification (see 3.6), and workmanship (see 3.8), and measured for compliance with width and coil diameter (see 3.4). Unless any defective portions of the coil, which fail to conform to the above requirements, can be removed and respliced, the lot represented by the coil shall be rejected.
- 4.5 Quality conformance tests:
- 4.5.1 Chemical analysis: Each sample selected in accordance with 4.3.1.2 and prepared in accordance with 4.3.2.1 shall be tested in accordance with Method 111 or Method 112 of FED-STD-151 to determine conformance to the chemical requirements of Table I. In case of dispute, the chemical analysis by wet chemical methods shall be the basis for acceptance. If the sample fails to conform to the requirements of Table I, the lot shall be rejected.
- 4.5.2 Mechanical properties:
- 4.5.2.1 Tensile strength: Specimens for tension test, prepared in accordance with 4.3.2.2.1 or 4.3.2.2.2 shall be tested for tensile strength in accordance with ASTM E 345 to determine conformance to the requirements of Table II. If the specimens fail to conform to the requirements of Table II, the lot shall be rejected.

4.5.2.2 Yield strength: The yield strength of the tension test specimens shall be tested as detailed in ASTM E 345 to determine conformance to the requirements of Table II. If the specimens fail to conform to these requirements, the lot shall be rejected.

4.5.3 Thickness of foil:

4.5.3.1 Instrument measurement: Specimens for the thickness test, prepared in accordance with 4.3.2.3.1, shall be tested to determine conformance to the requirements of 3.3 by obtaining readings at 5 locations on the strip, namely, at each edge, at 1/4 of the width distance from each edge, and at the center. Thickness shall be measured by means of suitable measuring devices that are capable of measuring the thickness to the nearest 0.0001 inch. If any reading for specimen thickness fails to conform to the requirement of 3.3, the lot shall be rejected.

4.5.3.2 Thickness by weighing: Specimens for the thickness test, prepared in accordance with 4.3.2.3.2, shall be tested to determine conformance to the requirements of 3.3 in accordance with ASTM E 252. The following densities shall be used for d:

Alloy 2024	45.58 g/in <sup>3</sup>
3003	44.82
5052	43.85
5056	43.30

The average of at least two specimens shall be taken to obtain the thickness of the foil. If the average value fails to conform to the requirements of 3.3, the lot shall be rejected.

4.6 Rejection and retests:

4.6.1 Rejection: When one or more test specimens fail to meet any of the tests required, the lot represented by the specimen or specimens shall be rejected.

4.6.2 Retests: Retests shall be permitted in accordance with the requirements of FED-STD-151.

5. PACKAGING:

5.1 Preservation and packing:

All aluminum foil shall be packaged in accordance with the requirements of MIL-STD-649. Unless otherwise specified, coils shall be wound on 3 inch ID returnable steel cores. The steel cores shall be furnished either flush (ends of the core are flush with the ends of the coil) or extended as stated in the contract or purchase order (see 6.2.1). When extended cores are specified, the length of the steel cores shall be supplied in accordance with Table IV. Unless otherwise specified, foil shall be preserved, packaged, and packed in accordance with Level C of MIL-STD-649.

## 5.2 Marking:

In addition to any special markings required in the contract or order, marking for shipment shall be in accordance with MIL-STD-649.

## 6. NOTES:

### 6.1 Intended use:

The aluminum foil materials covered by this specification are intended for use in fabrication of core materials for sandwich construction and side facing (edge joining) of the core. Foil is defined as a rolled section of thickness less than 0.006 inch. Fabricated core materials, from products covered by this specification, are to conform to the requirements of MIL-C-7438, Core Material, Aluminum, for Sandwich Construction. Uncoated aluminum foil, conforming to the requirements of QQ-A-1876, is intended for food handling, food processing, for shielding or insulation of electronic components, or as a non-corrosive barrier between treated surfaces.

### 6.2 Ordering data:

#### 6.2.1 Acquisition requirements: Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Alloy designation and temper (see 1.2).
- c. Mechanical properties, other than specified (see 3.2).
- d. Yield strength determination to be required (see 3.2 and Table II).
- e. Thickness (see 3.3).
- f. If foil is to be furnished other than as rolled coil (see 3.4).
- g. Coil diameter, if larger than specified (see 3.4).
- h. Weight of foil (see 3.4).
- i. Width of foil (see 3.4).
- j. Splicing, if other than specified (see 3.5).
- k. Marking, if other than specified (see 3.6).
- l. Core for roll, if other than specified (see 5.1).
- m. Flush or extended core (see 5.1).
- n. Levels of preservation and packing, if other than specified (see 5.1).
- o. Additional markings (see 5.2).

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